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ABSTRACT

The future of electronic learning was explored in an analysis that viewed the provision of learning at a distance as a continuum and traced the evolution from distance learning to electronic learning to mobile learning in Europe and elsewhere. Special attention was paid to the following topics: (1) the impact of the industrial revolution, the electronics revolution of the 1980s, and the mobile revolution of the late 20th century on education and training; (2) the distance education strategies and techniques that constitute the foundation for the success of mobile learning; (3) the worldwide spread of electronic learning and arrival of mobile learning; (4) mobile learning initiatives and attempts to provide theoretical constructs for mobile learning; (5) mobile learning on screenphones, on personal digital assistants (PDAs), smartphones, and wireless application protocol (WAP) telephones; and (6) student use of mobile learning. The differences between individual students' acceptance of the new electronic technologies were generally related to their different learning styles and study preferences. Mobile learning, especially mobile learning involving mobile telephony, was seen as becoming a new sector of education and training provision whose future depends on solving the problems inherent in presenting training scenarios on mobile telephones. (Thirty-nine tables/figures are included. The bibliography lists 28 references.) (MN)

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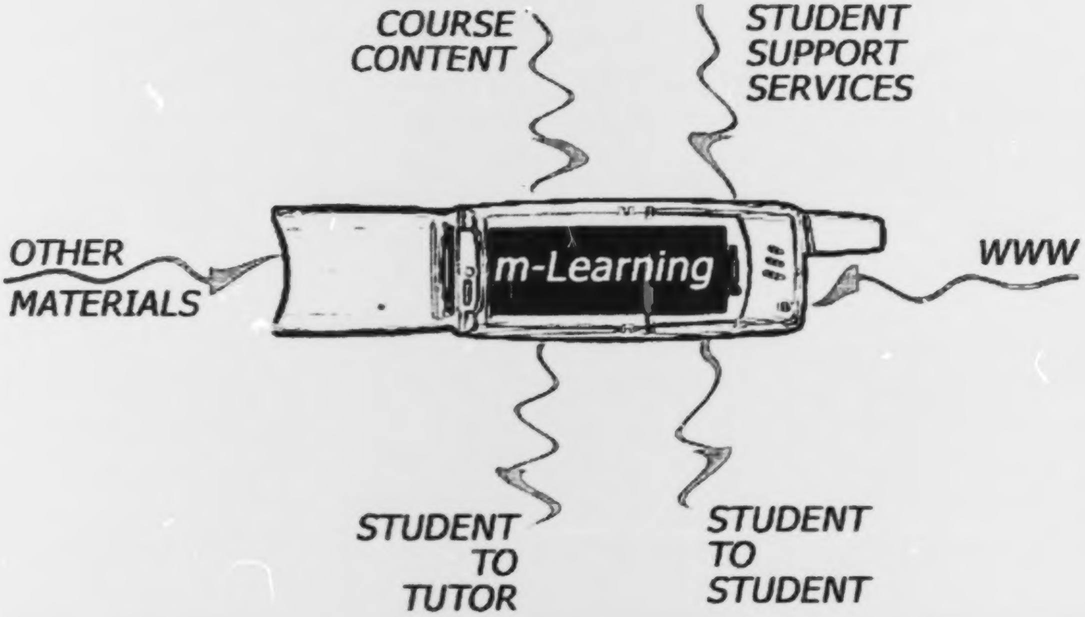
The future of learning:
From eLearning to mLearning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November 2002

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The future of learning:
From eLearning to mLearning

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INTRODUCTION

Grateful acknowledgement is made to the Leonardo da Vinci programme of the European Commission for part funding for this work.

The purpose of this book is to provide an analytical and theoretical background to the field of education and training provision known as mobile learning.

Mobile learning is seen as the provision of education and training courses on wireless devices: PDAs (Personal Digital Assistants), palmtops and mobile telephones.

The book sees the provision of education at a distance as a continuum and traces an evolution from d-learning (distance learning) to e-learning (electronic learning) to m-learning (mobile learning). No conflict is to be seen in these differing forms of provision. Clearly distance education continues to prosper with the arrival of e-learning, and both continue with the move to wirelessness in society. The vision is rather of the richness and choice that are available to learners in the 21st century.

Education at a distance is distinguished from conventional face-to-face provision and is seen as the provision of programmes for nationally and internationally accepted degrees, diplomas and certificates for students who legally and contractually do not reside at, or travel to, or attend in any continuous manner commensurate with the award, the training centres or colleges or universities providing the award.

Chapter 1 The future of learning treats the impact on education and training of the Industrial Revolution, an Electronics Revolution of the 1980s and a Mobile Revolution of the last years of the 20th century. It charts the move from the wired virtual learning environment of today to the wireless virtual learning environment of tomorrow.

Chapter 2 From d-learning to e-learning traces the distance education background. It argues that the strategies and techniques that brought success to distance education lie as a foundation for the success of mobile learning.

Chapter 3 From e-learning to m-learning gives the e-learning part of the continuum. It shows the worldwide spread of e-learning in the last years of the 20th century and the arrival of m-learning.

Chapter 4 m-learning initiatives today provides the necessary overview of activity in the field of mobile learning today. The vibrancy of the new sector of learning provision is demonstrated by 30 initiatives, including projects and European Union funded programmes. A number of the items are details of international conferences on mobile learning because it is at conferences that the strength and vitality of new innovative sectors of training can best be evaluated. The items conclude with three attempts which seek to provide theoretical constructs for mobile learning.

Chapter 5 m-learning on screenphones. It might have been thought that a wireless telephone with an A4 size screen would have been an ideal environment for mobile learning. The discontinuation of production of these devices brings the realisation that students would never have purchased one of these devices solely for study. It reinforces the conclusion that it is the universal availability of mobile telephony and the fact that citizens are used to carrying this technology around with them, that is the basis for mobile learning.

Chapter 6 m-learning on Personal Digital Assistants (PDAs) deals with the provision of mobile learning on PDAs, handhelds and palmtops. Considerable success has been achieved in the presentation of learning materials on these devices, with the Compaq iPaq being taken as the market leader.

Chapter 7 m-learning on smartphones. Smartphones are wireless telephones that include some of the functionality of a PDA, usually with a fold out screen that is considerably larger than that of a standard mobile telephone. This chapter describes innovative work as there is little provision of training materials on telephones.

Chapter 8 m-learning on WAP telephones. WAP telephones are wireless devices with a connection to the mobile internet. The small screen size is a problem and this chapter describes innovative work as there is little provision of training materials on telephones.

Chapter 9 Student use of mobile learning. There are few reports of student use of mobile learning. This chapter reports usage in Ireland, Norway, Germany and Italy and gives an overview of usage in Europe as a whole.

Chapter 10 Conclusions The future is wireless and this chapter looks forward to mobile learning becoming a new sector of education and training provision.

Desmond Keegan
Dublin
November 2002

CHAPTER 1. THE FUTURE OF LEARNING

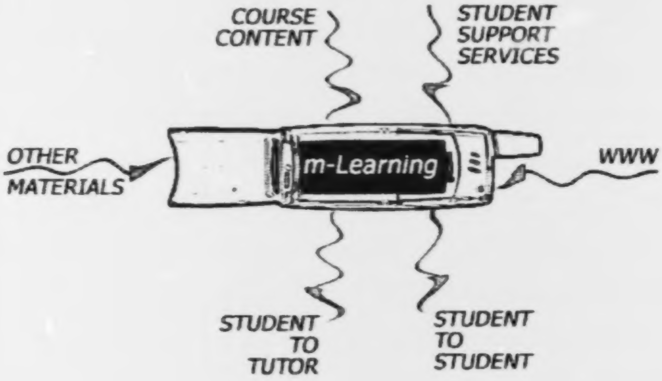
Mobile learning

Mobile learning is a harbinger of the future of learning.

Mobile learning sets out to design a learning environment for wireless technologies and provides this model of the environment:

It seeks to put in place a new virtual learning environment which might be represented thus:

Wireless Virtual Learning Environment of Tomorrow



At the dawn of the third millennium Ericsson and Nokia announced that there would be 1.000.000.000 mobile telephones in the world by 2002. The world population would be just over 6.000.000.000.

With the successful development of Bluetooth, WAP (Wireless Application Protocol), GPRS (General Packet Radio System) and UMTS (Universal Mobile Telecommunications System), the technological structures for wireless telephony and wireless computing are now firmly in place.
All over Europe today wireless technologies and applications are replacing wired ones: e-Commerce is moving to m-Commerce; m-Business is replacing e-Business; venture capitalists are snapping up WAP application providers as they appear; the site http://www.ericsson.se/letswap lists WAP applications for stock

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exchanges. booking flights the WAP way, instant mortgages over WAP, banking with WAP.

The list of 3G (third generation) wireless services is breathtaking, with applications already developed for refrigerators, business and the home. The move to wirelessness in telephony and computing is irreversible.

Only in the fields of education and training are there no applications in development or planning.

Mobile learningsets in place the first stage in the creation of a global provision of training on the wireless internet. It sets in place the first building block for the next generation of learning: the move from distance learning (d-Learning) and electronic learning (e-Learning) to mobile learning (m-Learning).

The status of learning

The evolution in education and training at a distance can be characterised as a move from dLearning (distance learning) to eLearning (electronic learning) to mLearning (mobile learning). These three stages of development correspond to the influence on society of the Industrial Revolution of the 18th to 19th centuries, the Electronics Revolution of the 1980s and the Wireless Revolution of the last years of the 20th century.

The Industrial Revolution

Distance education and training was born of the developments in technologies associated with the Industrial Revolution in Northern Europe and in North America in the late eighteenth and early nineteenth centuries.

It was no accident that teaching at a distance began with the development of industrial technologies, especially in postal communications and transport. The first trains and the first correspondence courses started at the same time.

Even today distance training would not be possible in a society that had not yet achieved an adequate level of industrialisation.

It is of interest that the government of North-Rhine Westphalia chose to locate its open university at Hagen, because the wire- and needle-making industries in the valleys of the Hönne, the Ihmertebach, the Oese and the Lenne, at towns around Hagen like Hemer, Iserlohn and Altena, were the harbingers of the Industrial Revolution from the 1680s onwards.

It is an interesting coincidence that the theory of distance training as the most industrialised form of teaching and learning was developed by Peters (1994) who was to become the first Rektor of the Distance University at Hagen.

Electronics Revolution

The telecommunications industry underwent swift and complex changes in the 1980s, which constitute an electronics revolution. These changes can be attributed to three factors:

- an urge to deregulate
- speeding up of chips
- introduction of broadband technologies.

Prior to the Electronics Revolution, governments regarded telecommunications as a lucrative, monopoly industry. It was linked to secret defence installations. There was total regulation. Development contracts were negotiated between the few monopoly providers and the military or government contractors.

Policies, however, associated with the Thatcher government in the United Kingdom led to open tenders, and a seeking for improved services, and better value for government money.

Policies associated with the Reagan government in the United States of America led to the breaking of monopolies, especially for the new cellular licences. Telecommunications became consumer driven.

Computing technology was introduced into telecommunications in the 1960s with the first public, analogue software switchboards dating from the mid-1970s. These were digitalised almost immediately, and were followed by the development of Integrated Services Digitalised Networking (ISDN) in the 1980s. In the 1990s, seamless digitalised connections between fixed and air networks were achieved. In all these developments, the ever-increasing speed of chips was crucial. The process will be accelerated with the replacement of silicon chips by nano-chips in the early 2000s.

The development of broadband technology is of vital importance for distance training, because one needs extensive bandwidth for pictures, audio, video and virtual realities. Broadband is usually defined as rates of more than 2 Mbits per second over a public switched network. Interactive multimedia, image processing, data and video are all large
consumers of bandwidth.

The electronics revolution of the 1980s led to group-based distance training and opened the way to the net and the web.

A Mobile Revolution

In late 1999 the population of the world reached six billion for the first time. Almost the same day Ericsson and Nokia announced that there were 500,000,000 mobile phones in the world and there would be one billion by 2004.

The mobile revolution has arrived.

The electronics revolution of the 1980s changed the nature of distance education, making it possible to teach face-to-face at a distance, to restore eye-to-eye contact electronically, and to teach groups as well as individuals at a distance. The mobile revolution of the late 1990s will change the distance student from a citizen who chooses not to go to college, to a person who not only chooses not to go to college, but is moving at a distance from the college.

The development of the didactic structures for the implementation of the mobile revolution will fall largely to the open universities and the government distance-training systems, as there is little likelihood that universities will focus didactically on students who choose to be mobile away from them.

If there is a rule about the choice of technology for distance training it is that technologies that are available to citizens may succeed. Rarely has a technology penetrated so quickly and so widely as the mobile telephone.

There is an unprecedented takeup of wireless telephones and wireless computers in developed and developing countries alike. The World Wide Web and the Internet are not enough, says the telecommunications industry: wireless access independent of location and Internet services everywhere is the requirement. The air interface is replacing the wire interface.

At the time of writing we have only seen the beginning of the wireless information society. But the protocols for provision are already being put in place: Bluetooth, GPRS, WAP.

Bluetooth is the universal radio interface for wireless connectivity. Previous portable devices used infrared links, were limited to 2m, were sensitive to direction, needed direct line-of-sight, could only link two devices. By contrast, the Bluetooth air connectivity uses radio links, which have much greater range, can function around objects, can go through certain materials, can connect to many devices at the same time.

General packet radio system (GPRS) brings official data and internet connectivity to mobile terminals giving instant, transparent, IP access with no call set up time. Wireless access protocol (WAP) brings web browser usability of the Internet to mobile terminals. It provides data-oriented, non-voice, services, anywhere and at any time The major manufacturers are committed to global standardisation of third generation mobile systems in radio environments like wide-band code division multiple access.

The challenge for distance systems at the dawn of the third millennium is to develop didactic environments for mobile phones and mobile computers as the availability of mobile devices spreads to a billion users. The mobile telephone is becoming a trusted, personal device with Internet access, smart card usage, and a range of possibilities for keeping the distance student in touch with the institution's student support services, in contact with learning materials and fellow students, while at home, or at work, or travelling.

Statistics

The statistics of mobile telephone availability are an indicator of the need for mLearning.

In distance learning history, systems have always followed the availability of the technology near the distance students. Technologies with excellent didactic facilities, like 12" laser discs in the early 1990s, were not a success because they were not available in the homes of students.

There has never been a technology that has penetrated the world with the depth and rapidity of mobile telephony. Over 500.000.000 are available today with forecasts from Ericsson and Nokia stating that there will shortly be 1.000.000.000 in a world population of 6.000.000.000.

This penetration has been in both the developed and developing world. Statistics released by Ericsson in mid-2001 showed that communist China had the world's greatest number of mobile phones at 170.000.000, ahead of both the USA and Japan.

Empowering Technologies provide in 2001 telling statistics about the Mobile Learning Era:

The Mobile Learning Era

The evidence is overwhelming that mobile learning is beginning to take hold:

- Over 50 percent of all employees spend up to half of their time outside the office.

- More than 75 percent of all Internet viewing will be carried out on wireless platforms by 2002.
- Mobile devices will outnumber landline PCs by 2002 and exceed the 1 billion mark the following year.
- More than 525 million web-enabled phones will be shipped by 2003.
- Worldwide mobile commerce market will reach $200 billion by 2004.
- There will be more than 1 billion wireless internet subscribers worldwide by 2005.

Of particular importance is the statement that mobile devices will outnumber landline PCs by 2002 and exceed the 1 billion mark the following year.

The nature of technology in learning

Throughout the 20th century there were developments of the role of technology in learning.

Pressey's testing machine of 1926-27 is well known but his main contribution to educational technology lay not so much in his machine as in his strong belief that an industrial revolution in education was about to dawn, bringing great benefits of more effective and more efficient learning. He pursued this dream for several decades, although he had little time for programmed learning or for teaching machines when these came along. Even his own machines were thrown away in favour of a small card with blobs of ink on it; the learner erased the blob over the answer he thought correct, and underneath was a symbol that told him whether he was right.

"We are on the threshold of an exciting and revolutionary period, in which the scientific study of man will be put to work in man's best interest. Education must play its part. It must accept that a sweeping revision of educational practices is possible and inevitable". With such evalgelising zeal did Skinner write in his 1954 article *The Science of Learning and the Art of Teaching.*

Skinner saw four serious shortcomings in the educational system:

- The reinforcers used were still aversive
- They were used too long after responses had been elicited
- The progression towards the required behaviour was poorly arranged
- Reinforcement was provided too infrequently.

Skinner suggested that few teachers, if any, could remedy these shortcomings working alone with a group of pupils and proposed that machines might be employed to perform most of the function the teacher could not perform, as well as some of those she could. Skinner saw programmed learning and teaching machines as part (if not all) of an overall improvement in teaching techniques.

The use of technology in learning is different in its use in traditional group-based face-to-face teaching and in distance education, which is frequently individual-based and separates the learner not only from the teacher but also from the learning group.

Traditional group-based face-to-face education and training has used technology as a *supplement to* the teacher, and differs from distance education in which technology is a *substitute for* the teacher. However, in the late 1990s, with the arrival of the WWW and the provision of some universities of web based courses in place of lectures, the web has become an option on the campus as well as at a distance.

In distance education one can follow the development of a series of developments of the use of technology for teaching. The first generation uses the technology of printing and was basically the provision of print based materials for learning. A second generation added multimedia including audio, video and CD Roms to replace or supplement the print-based materials. The third generation of the 1990s was the impact of eLearning and the arrival of the WWW.

There is now little doubt that the World Wide Web is the most successful educational tool to have appeared in a long time. It combines and integrates text, audio and video with interaction amongst participants. It can be used on a global scale and is platform independent. While largely an asynchronous medium, it can also be used for synchronous events. It is not surprising therefore, that trainers, lecturers, distance education providers and teaching institutions at all levels are increasingly using the World Wide Web as a medium for course provision (Mason 1998).

The future of technology

Present day technologies are presented by Bates in *The Changing Faces of Virtual Education* (2001) thus:

> The Web is becoming a dominant technology where people have access to it. Because of its capacity to reach thousands of learners with a service of a defined standard, satellite broadcasting still plays a valuable role in many developing countries where a large number of learners do not have access to the Intenet. Videoconferencing, on the other hand,m has limited uses, is dependent on very low telecommunications costs and lacks the flexibility and potential of the Web.

The challenge for distance systems at the dawn of the third millennium is to develop didactic environments for mobile phones and mobile computers as the availability of mobile devices spreads to a billion users. The mobile telephone is becoming a trusted, personal device with Internet access, smart card usage, and a range of possibilities for keeping the distance student in touch with the institution's student support services, in contact with learning materials and fellow students, while at home, or at work, or travelling.

The mid 2000s seem to be the indication for the general availability of voice synthesis, voice recognition and voice input into telephones and computers, whether fixed or mobile. There should again be benefits for distance systems rather than on campus, because of the greater reliance of distance students on correspondence, assignment preparation, and assignment submission.

Far from seeing conflict in the tensions listed above, the vision here is of the richness and choice that confronts the learner in the twenty-first century for both education and training: schools, colleges and universities will continue to prosper, as will systems based on teaching at a distance. Teaching face-to-face at a distance in virtual and electronic systems will continue to prosper, as will training on the World Wide Web. To these will be added the boon of Bluetooth and mobile technologies, with the elimination of wiring and fixed installations for many applications, and the further blessing of voice input into machines.

The future of learning

ELearning is the state of the art in distance learning at the time of writing.

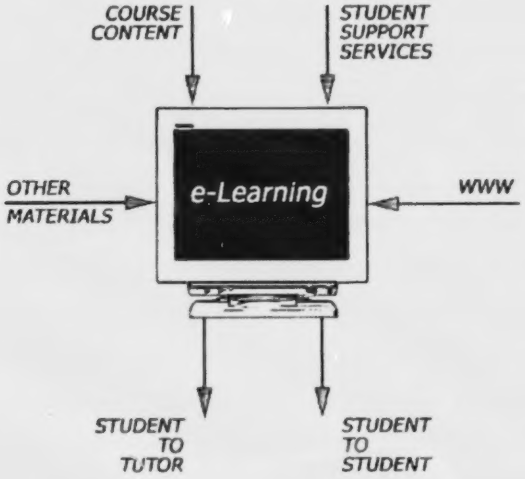
Many have seen it as the 'killer application' for telelearning as in Collis' *Telelearning in a digital world: The future of distance learning* (1996). ELearning means the award of nationally and internationally recognised university degrees, college diplomas and training certificates to saudents who spend all or much of their study programme sitting in front of a computer.

It is not yet clear that the distance learning market in Europe has been transferred from print-based courses to eLearning but a growing number of institutions are providing some electronic component in their distance systems, even if it is only an email contact to the administration or the tutor. At conferences and groupings of distance educators, however, the talk is all of eLearning and pre-electronic forms of distance education are scarcely discussed.

The next task of the future is to build the same systems for wireless computing and telephony as eLearning has provided for wired computing and telephony.

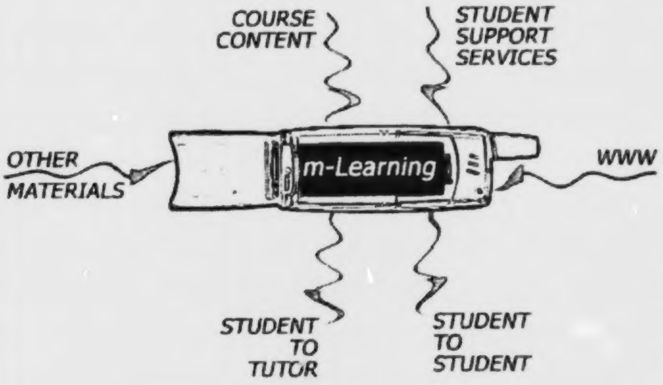
The wired learning environment of today might be presented diagrammatically thus:

Wired Virtual Learning Environment of Today


COURSE CONTENT
STUDENT SUPPORT SERVICES
OTHER MATERIALS
e-Learning
WWW
STUDENT TO TUTOR
STUDENT TO STUDENT

Mobile learning seeks to put in place a new virtual learning environment for the future which might be represented thus:

Wireless Virtual Learning Environment of Tomorrow


COURSE CONTENT
STUDENT SUPPORT SERVICES
OTHER MATERIALS
m-Learning
WWW
STUDENT TO TUTOR
STUDENT TO STUDENT

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This will be followed by the mid 2000s by the introduction of voice input and voice recognition into wireless devices to create a more user-friendly environment for learners.

Overview

This book seeks to present mobile learning within the context of distance learning (dLearning) and electronic learning (eLearning). It traces an evolution from distance to electronic to mobile strategies for learning which correspond to the societal evolution from the Industrial Revolution to the Electronics Revolution of the 1980s to what may be termed a Mobile Revolution of the closing years of the 20th century.

CHAPTER 2. FROM DLEARNING TO ELEARNING

The nature of dLearning: definition

dLearning refers to distance learning.

Distance education is used in this study in its legal sense for the provision, either public or private, of education and training for nationally recognised degrees, diplomas and certificates, to students who choose not to, or who are unable to, or who refuse to, attend the schools, the colleges, and the universities which society provides for the purposes of learning.

Clearly the choice of terminology like, 'students who refuse to go to college' is that of the analyst or the stocktaker, and would not be used by stakeholders who choose to champion distance learning or criticise campus universities.

There will always be a need for a term to characterise the sector of education which offers educational qualifications to those students who do not attend educational institutions, and it seems appropriate to use the well-established term *distance education* for this sector, whether the provision is made electronically or not.

Besides these legal dimensions, the study is based on a previously published definition: (Keegan 1996:50)

Distance education is a form of education characterised by:

- The quasi-permanent separation of teacher and learner throughout the length of the learning process (this distinguishes it from conventional face-to-face education);
- The influence of an educational organisation both in the planning and preparation of learning materials and in the provision of student support services (this distinguishes it from private study and teach-yourself programmes);
- The use of technical media – print, audio, video or computer, or the world wide web, to unite teacher and learner and carry the content of the course;
- The provision of two-way communication so that the student may benefit from or even initiate dialogue (this distinguishes it from other uses of technology in education); and

- The quasi-permanent absence of the learning group through-out the length of the learning process so that people are usually taught as individuals rather than in groups, with the possibility of meetings, either face-to-face or by electronic means, for both didactic and socialisation purposes.

The World Bank web site gives shorter definitions in its glossary of distance education terms at http://wbweb4.worldbank.org/Distant/glossary.html.

Distance education: Teaching and learning in which learning normally occurs in a different place from teaching.
Distance learning: Term often used as synonymous with distance education, not strictly correctly since distance education includes teaching as well as learning.

The question raised by these concepts for the analyst is that society has for some hundreds, if not thousands of years, provided itself with locations called schools, and higher level locations called universities, at which the teaching-learning interaction takes place. The question for the analyst is whether institutional learning is essentially linked to these privileged places for institutional learning created by society.

Distance education students choose to remain in employment, at home with their families. They refuse to give up their jobs to study. They expect to be given institutional learning at home and, more and more frequently as the new millennium starts, university degrees at home, isolated in front of a screen. The ideas of Von Humboldt, or Arnold, or Newman that universities are places where students come together for the purposes of learning, do not convince them to travel to colleges and to reside at them.

Historians of Western education trace the origins of conventional face-to-face education back through the centuries, showing how it evolved through the dialogue, lecture, seminar, tutorial, laboratory practical and library resource centre to the provision in schools, colleges and universities today. This is characterised by (i) face-to-face provision, (ii) between teacher and learner in the learning group. (iii) based on interpersonal communication.

Teaching at a distance (dLearning) is more recent going back only 150 years to the developments of technology associated with the Industrial Revolution, especially in transport and communications. It is characterised by the separation of the teacher and the learner and of the learner from the learning group, with the interpersonal communication of conventional education being replace by a mode of communication mediated by technology. Correspondence schools, open universities and other structures of today provide this complement and enrichment of conventional provision.

The first distance educators made it possible for the first time in history to learn at a distance by separating the teacher from the learner and separating the learner from the learning group. This brought great benefits to learners as it freed them from the timetabling of lectures and of training sessions in the company training centre and enabled them to learn at times of their own choosing and in places not specifically designed for learning.

Rapid advances in information technology associated with what may be called an electronics revolution of the 1980s made it possible for the first time in history to teach face-to-face at a distance. By electronically linking students and teacher at various locations by cable, microwave ion satellite it becomes possible to create a virtual classroom.

Two forms of dLearning

As the third millennium starts, the impact of distance systems is demonstrated by the development of both group-based distance training systems, and of systems for individual learners.

Group-based dLearning systems are referred to as 'distance learning' in the United States while individual-based systems are referred to as 'distance education' in Europe.

In this analysis group-based systems are divided into systems for full-time students and systems for part-time students, whereas systems for individual learners are best described as being based on pre-prepared learning materials, or not providing pre-prepared materials.

Group-based distance training links the teacher and the learners in several geographic locations by simultaneous audio, video, or satellite links, to a network of remote classrooms.

Group-based distance training for full-time students

Research on the Chinese *Zhongguo guangbo dianshi daxue (Dianda)* system in 1989 (Keegan 1993) showed that it was a network of radio and television universities for largely group-based, full-time students. The *Dianda* network uses satellite technologies to reach groups of students throughout the country.

Television and other distance learning materials are produced, mainly, by the Central Chinese Radio and Television University (CRTVU) in Beijing, which prepares the materials but does not enrol students. The television lectures are distributed by satellite links to students enrolled in, and grouped at, the forty-four open universities throughout the country, where tutors are present and learning materials are studied.

The statistics show that 97 per cent of the *Dianda* network enrolment in the mid 1980s was full-time students at a distance, with the figure dropping to 16 per cent recently. Total enrolment varied between 500.000 and 800.000 per year.

Today the percentage of full-time students is below 10 per cent as the spread of the capitalist ideology in China has largely eliminated study leave for distance training.

In the 1980s the full-time students in the *Dianda* system received three years study leave on full pay to complete their degree. They travelled on a daily basis to their factory or workplace, where they went to the education centre, rather than their place of work. Their daily study programme began with the first of the live television lectures from Beijing, and these lectures were interspersed with tutor-led discussions and assignment work.

In the category of group-based distance education for full-time students one should also include much of children's distance study.

Distance education for children was initiated by the Australian state governments from 1914. By the mid 1920s all the state and provincial governments of Australia, Canada and New Zealand had a full-time distance education provision for children. To these were later added the Schools of the Air for outback children in Queensland, New South Wales and South Australia where short wave radio links and, today, web-based links unite isolated students on large farming properties in class groupings.

More recently, since 1939, the French government through its Centre National d'Enseignement à Distance (CNED) provides a full-time distance education provision for children globally.

The scientific importance of studying group-based distance training for full-time students, is that it gives important data and can correct research viruses in studies which have been undertaken without counting the full-time students.

Full-time distance students, for instance, do not drop-out any more than students in full-time face-to-face provision. They take the same length of time to study a diploma or degree programme as students in conventional colleges or universities. Children also do not drop out from distance education programmes, nor do they take longer for their studies than their counterparts in schools.

Group-based distance training for part-time students

Just as the wondrous developments of technologies in the Industrial Revolution of the mid-nineteenth century brought to students worldwide the benefits of individual-based distance education, so the wondrous developments of technologies in an Electronics Revolution of the 1980s brought students the benefits of group-based distance education.

This is the dominant mode of provision in the United States of America, where distance learning has become a major form of educational provision and of business training. It has an active organisation, the United States Distance Learning Association (USDLA), to promote its interests. This professional distance education association groups multinational and corporate providers with the universities. This mode of distance education comprises preprepared materials, satellite lectures and individual study at home.

In practice, distance learning can mean that the university professor at a large number of US universities, proceeds to the lecture theatre to deliver his or her lecture to the students assembled there, and the lecture is up-linked to a satellite, from which it is down-linked to groupings of students assembled in other locations throughout the state or the nation. These students are usually linked to the central lecture theatre by a telephone hook-up.

One-way video, two-way audio satellite, or two-way video, two-way audio compressed videoconferencing, are perhaps the dominant technologies at the start of the third millennium, but a wide range of options is available.

At the turn of the millennium, most of the hundreds of thousands of students in the Chinese *Dianda* system are properly located in this category, as part-time training has replaced full-time study at a distance.

European theorists have been slow to acknowledge the rapid spread of group-based systems as a complement to the individualised systems with which they are more familiar. The dimensions of the field cannot be appreciated without considering both modes. Misunderstandings in the literature can arise from trying to treat both modes of provision identically, without appreciating the crucial didactic and logistical differences between teaching adults in groups or as individuals.

Similarly, another standard form of provision of group-based distance training in the United States of America: two-way video, two-way audio compressed digital video conferencing has also had little success in Europe.

In the United States, it is regarded as a form of provision for, say, a masters degree in nursing at the University of Albuquerque, in which full-time nurses, working in hospitals, as much as 300 kilometres from Albuquerque, take their courses. In American practice, it is considered sensible to provide these professional qualifications, even at a videoconferencing rate as low as 112k per second, to students who would otherwise have to drive 300 kilometres to Albuquerque, after a long day's work in the hospital, and then drive the 300 kilometres back, to resume work in their hospital.

Individual-based distance training

Over the last 150 years nearly all European distance training has been individual-based with pre-prepared materials. This has tended to focus European practitioners and theorists on this mode of provision. Again it is possible to identify two subsystems of this mode of provision: systems based on pre-prepared materials and systems without pre-prepared materials.

Individual based distance education with pre-prepared materials

Developments of communication technologies in the 1840s in Northern Europe and North America, laid the basis for training at a distance. For the first time it became possible to separate the teacher from the learner, and the learner from the learning group, and for students to learn from teachers individually at any place or at any time they chose.

Individual-based distance systems are to be found worldwide. The major characteristics of these systems are the scientific preparation of distance materials for individual learners, and the design of student support systems for students studying individually at a distance.

In this way, students worldwide benefit from being freed from the tyranny of timetabling: travelling at fixed times and on fixed days to join other persons at universities and training centres for the purpose of being trained. Learning systems were also freed from streaming: the inherent characteristic of conventional face-to-face group-based education and training in which students of varying intelligence and of varying studying backgrounds, and of varying degrees of motivation, are taught the same content in the same groups. The invariable result has been the holding back of the highly intelligent and the highly motivated, with slower or inferior learners learning less then they might.

The rapid development of the internet in the years 1995 to 1999 has created a new global dimension for this form of training provision, as individuals all over the world study for degrees or other qualifications from their computer screens either at home or at work.

In the period 1995 to 2000 the whole world was going mobile, as mobile telephones and mobile computers allowed individual students anywhere to study their courses and communicate with the university while travelling.

As the third millennium commenced, the wireless linking of students travelling at a distance in individual-based distance systems, with pre-prepared materials, is the latest possibility, creating not just students studying at a distance, but the student studying while travelling at a distance as well.

Most of the European systems are correctly located in this classification whichever of the four major models they follow: the open university model, the government distance training institution model, the private distance training institution model, or the provision of training at a distance from conventional universities model.

In spite of the extensive provision of group-based distance education in China, there is very extensive provision of individual-based distance education as well.

At least one million students in China are enrolled each year in programmes which can be labelled correspondence education. There are several kinds of correspondence education in China but by far the largest is that sponsored by the conventional universities. It is widely used in teacher training and general higher education, as, for example, at the People's University in Beijing. Correspondence education has been localised in the various Chinese universities in their surrounding areas but has nationally become the biggest contributor of diploma and degree graduates at a distance to higher education.

In spite of the extensive provision of group-based distance education from conventional universities in the United States of America, there is a very large provision of individual-based distance education with pre-prepared materials as well.

In the proprietary sector, these providers are grouped in The Distance Education and Training Council (DETC), based in Washington DC, which groups military, church and business organisations providing training at a distance throughout the United States of America.

Allied to this is the provision through universities affiliated to The National University Continuing Education Association (NUCEA), which groups departments in many United States universities, which provide distance training courses to individual students studying at a distance, rather than the electronic groupings of students analysed in the previous section.

There is now little doubt that the World Wide Web is the most successful educational and training tool to have appeared in a long time. It combines and integrates text, audio, and video, with interaction amongst participants. It can be used on global scale and is platform independent. While largely an asynchronous medium it can be used also for synchronous events. It is not surprising therefore, that trainers, lecturers, distance education providers and teaching institutions at all levels are increasingly using the web as a medium for training.

In spite of the possibility of linking distance students electronically and synchronously on the web, the vast bulk of web-based provision is properly located in the category of individual-based distance education with pre-prepared materials.

Individual-based distance education with pre-prepared materials is the proper location for nearly all the open universities throughout the world. Many of the open universities were founded in the 1970s and the 1980s and are now national institutions of great prestige and excellent quality. Few are new or experimental. Most have decades of experience and tens of thousands of graduates already integrated into the national workforce. Such institutions form an important focus for the study of distance training and underline the contribution that this form of provision makes in developed and emerging economies alike.

Most Canadian and Australian systems would also correctly be located in the category of individual-based distance training with pre-prepared materials. Systems in the rest of the world, which do not clearly fall into the group-based distance training categories in the classification provided, are also located here.

Individual based distance training without pre-prepared materials

The external degree programme of the University of London dates from about 1840 and lasts until today. This individual-based distance provision without pre-prepared materials predates the development of pre-prepared materials for distance systems, usually put in the years 1855 to 1880.

Simply put, these systems enrol individual students at a distance and, in the case of the University of London, from all over the world, and provide the enrolled students with syllabuses, content description, reading lists and previous examination papers.

The students then choose their method of study. They can study at a local college or a university - if they can find a programme that resembles the distance programme in which they are enrolled. Many of the British distance education colleges, like Wolsely Hall, started precisely to provide courses for the University of London External Degree programme. Alternatively the students can study completely individually, buy or borrow the textbooks on the reading list, and then present themselves for the examination.

The distinctions between the American distance learning based largely on synchronous communication technologies and the European distance education based in the main on asynchronous technologies is important because it influences development in both eLearning and mLearning.

The history of dLearning

Distance learning began in the second half of the 19th century when for the first time in history the first distance educators separated the teacher from the learner and the learner from the learning group. The first courses were proprietary but university courses followed in the closing decades of the 19th century. The University of Queensland in Australia in 1909 became the first university with obligations in its charter for the education of the whole population of the state and not just for the city in which the university was located.

An essential feature of distance education is that the teaching acts are separated in time and place from the learning acts. The learning materials may be offered to students, one five ion ten years after they were developed and to students spread throughout a nation or overseas. In distance education a teacher prepares learning materials from which he ion she may never teach. Another teacher may use the materials and evaluate students' learning. The pedagogical structuring of the learning materials, instructional design, and execution may be assigned to persons other than the teacher and to persons not skilled in the content to be taught. Teaching becomes institutionalized; the course may continue in use after the lecturer responsible for producing it has died or left the institution. Materials may be developed by a course team or staff group.

For all these reasons the first years of distance learning, were difficult and the sector was looked down upon. It was difficult to get university credit ion accreditation for the courses taught and the awards offered. Until quite recently in the United States it was impossible to study for a whole degree at a distance and dLearning credits could only support a programme studied mainly on campus.

1970s and the foundation of the open universities

Giant strides in both quality and quantity of provision were made with the foundation of the European open universities at the start of the 1970s. The Open University of the United Kingdom at Milton Keynes was founded in 1969, the Universidade Nacional de Educacion a Distancia at Madrid in 1972 and the Fernuniversität-Gesamthochschule in Hagen in Germany in 1975.

These were national institutions of great prestige, linked to other national institutions like the BBC. With large numbers of full-time staff for research and development, these universities brought about an immediate rise in quality. The structuring of content and the design of learning materials brought it about that the learning materials were accepted by other universities in the country. To this was added student support services of a comprehensive style which provided support for students studying at a distance.

As national institutions of great prestige their university degrees were accepted as the equivalent of other university degrees in the country.

1990s and the impact of the WWW

The development of distance learning in the United States and its reliance on the synchronous communications technologies of an Electronics Revolution in the 1980s, paved the way for eLearning. Experience with satellite transmission of courses and videoconferencing and other communications technologies gave the impetus for training on the WWW and gave American universities and companies leadership in the emergence of web-based learning standards.

There is now little doubt that the World Wide Web is the most successful educational tool to have appeared in a long time. It combines and integrates text, audio and video with interaction amongst participants. It can be used on a global scale and is platform independent. While largely an asynchronous medium, it can also be used for synchronous events. It is not surprising therefore, that trainers, lecturers, distance education providers and teaching institutions at all levels are increasingly using the World Wide Web as a medium for course provision.

By 1998 the provision of education and training on the internet and on the World Wide Web was already a mature field of distance training provision. This was demonstrated by the European Commission project, *Courses on the Internet: surveys, analyses, evaluation, recommendations* (CISAER), published on the net at http://www.nki.no/~morten/cisaer.

In surveying and analysing training provision on the World Wide Web, this project carried out a series of eighty in-depth interviews in mid 1998, with world leaders in virtual education. These experts, from a wide range of countries, talked in long distance telephone interviews with confidence and expertise on issues of server provision, of kernel choice and of system design. They analysed changes in systems and systems design, when one moved from 200 students on the web, to 2,000 students on the web, to 20,000 students on the web.

There could be no doubt from these interviews and the surveys published on the CISAER website, that by 1998 training on the World Wide Web was a mature and professional field of provision, with its own rules, structures, achievements and literature.

This is remarkable because Collis (1996) in her *Telelearning in a digital world: the future of distance learning* was able to identify the origins of this field of training provision, to the period from late 1994 to early 1995.

By 1997, Fritsch, in Germany, had started the analysis of a new training market. He identified students who:

- spent more than twenty hours a week working in front of a screen,
- had a company or university link to the internet,
- could write or edit a page in html
- wanted to be trained in front of their screen.

It seems remarkable that, by 1997, there was a new market of persons who spent most of their day in front of a computer screen and wanted to be trained in front of their screen too.

Systematic evaluation began early too. Boshier, a professor of adult education at the University of British Columbia, tells how he led a team of researchers to comb the web between 15 February 1997 and 10 April 1997 for courses. His findings, already published in major articles in *Distance Education* in 1997 and 1998, under the jazzy titles 'Best and worst dressed web courses: Strutting into the twenty-first century in comfort and style' and 'World Wide America? Think globally, click locally' state:

Web courses are constructed as the answer to fiscal crises evoked by neo-liberal restructuring. They are also touted as an anarchist exemplar of 'de-schooling' as envisaged by Ivan Illich. The trouble is, some courses are vastly under-dressed and merely attempt to display a face-to-face course on-line. At the other extreme are those laced with links, animation and more than enough glitter and glam to make Liberace wince. In this study the authors employed a 43-item coding schedule to examine the accessibility, opportunities for interaction and attractiveness of 127 courses on the web (1997:327).

and:

The web assists the globalisation process but, as Canadians, we are apprehensive about US dominance. The problem will partly be overcome as more non-American sites are posted and search engines deployed. In the meantime, educators outside the US committed to building their own nation and preserving its culture and sense of itself, should think about how to develop local Web resources so as to rely less on the US (1998:121).

Is the new area of web-based training to be regarded as a form of conventional education, or a form of distance education, or does it constitute a new sector of educational endeavour and a new field of educational research?

The position taken up here is that web-based education is best regarded as a subset of distance education and that the skills, literature, and practical management decisions that have been developed in the form of educational provision known as 'distance education', will be applicable *matatis mutandis* to web-based education. It also follows that the literature of the field of educational research known as distance education, is of value for those embarking on training on the web.

Not all would agree.

In her *Telelearning in a digital world: the future of distance learning*, Collis sees the WWW as an innovation in education worldwide in which children in schools will be taught on the web, students who travel daily to universities will be taught on the web as well as or instead of the lecture theatre, students at work will be taught on the web, students at home will be taught on the web, and students globally will be taught on the web.

In spite of the position of Collis and others who share similar positions to hers, it is considered here that the legal distinctions should be decisive. A student either contracts with a conventional school, college, or university to attend that institution, to join its community of students, and to receive its certificate or diploma or degree. Whether this student receives the qualification by attending classes or lectures, working in the library, or the laboratory, or at a computer screen, or on the WWW, depends on the legal requirements stipulated in the statutes of the institution.

Distance education is different. The student legally chooses not to attend the institution, or is unable to (for example, if in prison), or chooses not to (for example, if disabled), and requires the institution to award him or her its certificate or diploma or degree without joining its community of scholars. There need, in fact, be no physical institution for the student to attend in distance training, because the educational environment, in which the teaching-learning interaction which constitutes the education process, is artificially created.

Whether this student receives the qualification by studying printed materials, or audio materials, or video materials, or computer materials, or on the WWW, and whether the student studies at an airport, or at home, or at work, and whether communication between students is compulsory or optional, face-to-face or electronic, depends on the didactic and administrative decisions made by the institution.

In spite of the possibility of synchronous WWW didactic interactions, it is considered that web-based training is predominantly an individual-based form of educational provision. In spite of the possibility of full-time, on-campus students using the web for part of their degree, it is considered that web-based training can be accommodated within the existing structures of distance training and there appears to be no necessity for the development of a new sector of educational endeavour or a new field of educational research to accommodate it.

The acceptance of dLearning

By the start of the third millennium, and in spite of the arrival of eLearning, distance learning had established itself as a valid field of educational endeavour complementary to and side by side with conventional provision.

University degrees won at a distance and college diplomas and training certification won at a distance were nationally and internationally accepted in the main.

Much of the groundwork for the acceptance of university degrees won by eLearning and eventually by mLearning provision was achieved by the field of dLearning.

CHAPTER 3. FROM ELEARNING TO MLEARNING

Statistics

The arrival of eLearning can best be demonstrated by statistics at 1.1.2000 such as;

- there were about one million courses on the internet, 30,000 of them complying with a scientific definition of online, 22,000 of these were listed on the Telecampus portal, with many of them making didactic use of the World Wide Web
- e-learning includes online learning, web-based training, virtual universities and classrooms, digital collaboration and technology assisted distance learning
- WebCT kernel alone was used by 5.100.000 students in 123.000 courses, developed by 33.000 university and college faculty at 1.100 institutions in 48 countries
- CISCO systems stated that more than half of all technical training will be done by e-learning by the year 2003
- That Irish e-learning company Riverdeep was launched on the New York Nasdaq exchange in March 2000 for the market capitalisation of $1.000,000,000
- The e-learning part of vocational education and training (VET) is now big business.
- The European Union's training deficit in this sector and that of EU government and proprietary providers is dramatic.
- In 1998, the Open University of the United Kingdom reported that 50.000 of its students were online and that they sent 70.000.000 emails and that these were read 700.000.000 times.
- In the year 1999, the Open University of Hong Kong, reported that it had 500.000 volumes in its online virtual library for distance students and that in 1999 these volumes were used 5.200.000 times by its 25.000 students.

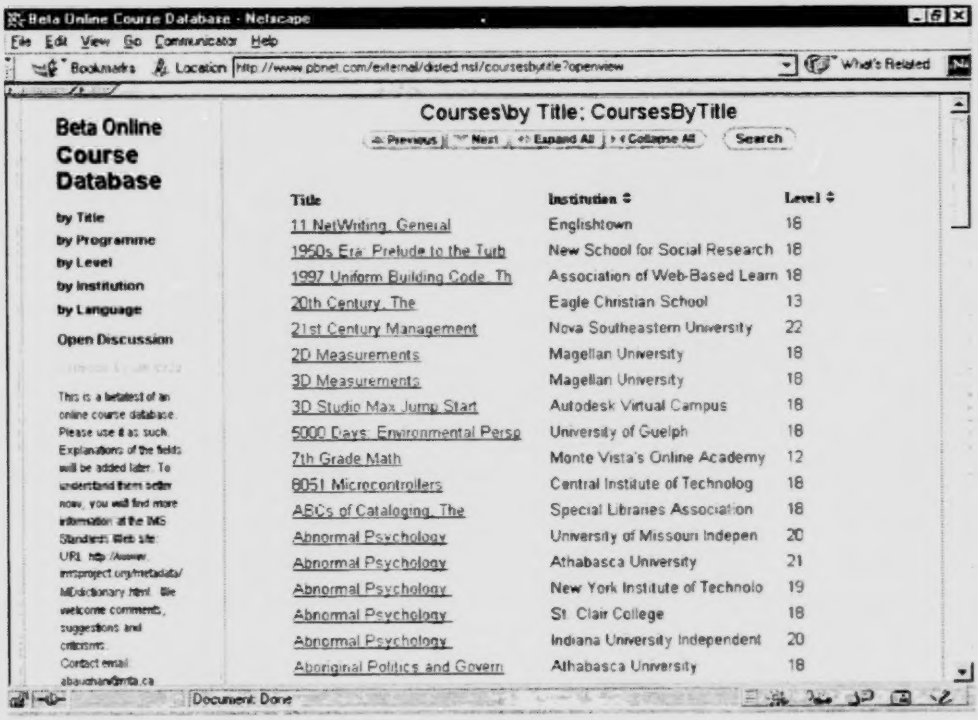
The collapse of the New York Nasdaq Index since March 2000 has reduced the value of Riverdeep but it remains a worthwhile investment.

Collis of the University of Twente showed that training on the WWW commenced in 1995. The development of the field as indicated by the statistics above in less than five years is staggering.

Further statistical information can be got from the leading eLearning portal, that of TeleEducation, New Brunswick, Canada.

By late 1999, a catalogue of on-line course at TeleEducation, New Brunswick had reached 17,000 entries out of their global estimate of 30,000 courses available. By mid-2002 their listing had reached 70.000 courses.

The 17,000 entries are listed on the web:


Beta Online Course Database - Netscape
File Edit View Go Communicator Help
Bookmarks Location http://www.pbnet.com/external/disted.nsf/coursesbytitle?openview
What's Related
Previous Next Expand All Collapse All Search
Document: Done

Beta Online Course Database

- by Title
- by Programme
- by Level
- by Institution
- by Language

Open Discussion

This is a betatest of an online course database. Please use it as such. Explanations of the fields will be added later. To understand them better now, you will find more information at the IMS Standards Web site: URL http://www.imsproject.org/metadata/MDdictionary.html. We welcome comments, suggestions and criticisms. Contact email: abauchan@mta.ca

Courses\by Title: CoursesByTitle

Title	Institution ⇕	Level ⇕
11 NetWriting, General	Englishtown	16
1950s Era: Prelude to the Turb	New School for Social Research	18
1997 Uniform Building Code, Th	Association of Web-Based Learn	18
20th Century, The	Eagle Christian School	13
21st Century Management	Nova Southeastern University	22
2D Measurements	Magellan University	18
3D Measurements	Magellan University	18
3D Studio Max Jump Start	Autodesk Virtual Campus	18
5000 Days: Environmental Perso	University of Guelph	18
7th Grade Math	Monte Vista's Online Academy	12
8051 Microcontrollers	Central Institute of Technolog	18
ABCs of Cataloging, The	Special Libraries Association	18
Abnormal Psychology	University of Missouri Indepen	20
Abnormal Psychology	Athabasca University	21
Abnormal Psychology	New York Institute of Technolo	19
Abnormal Psychology	St. Clair College	18
Abnormal Psychology	Indiana University Independent	20
Aboriginal Politics and Govern	Athabasca University	18

Listing of 17.000 online courses by TeleEducation, NewBrunswick

Each of the 17,000 courses in the catalogue was provided with an analysis in fifty-four categories at http://courses.telecampus.edu:

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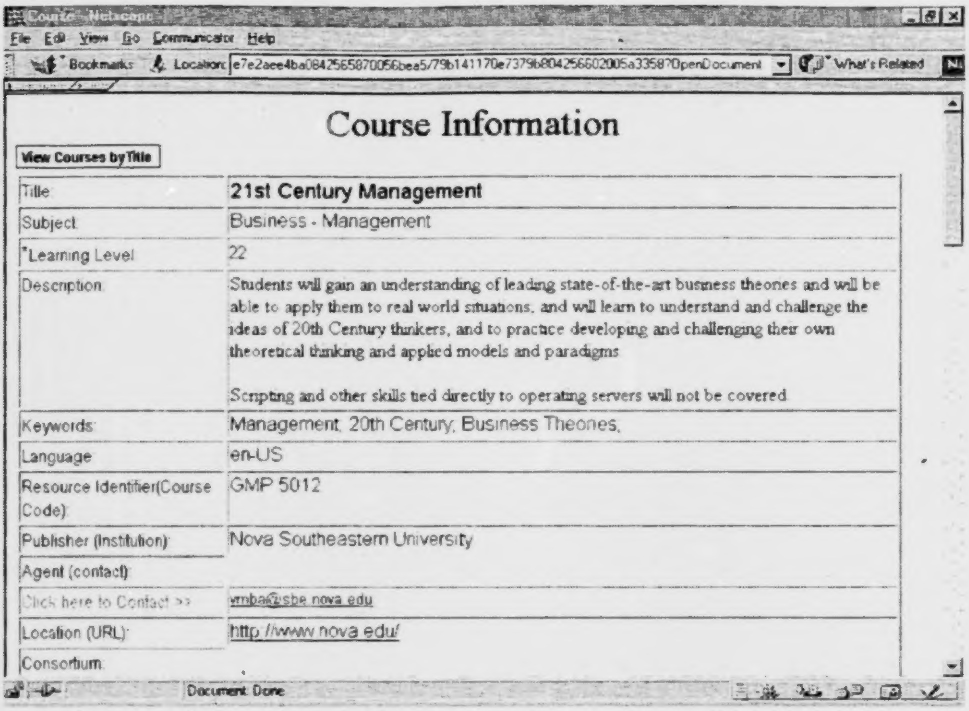
Course - Netscape
File Edit View Go Communicator Help
Bookmarks Location: e7e2aee4ba0842565870056bea5/79b141170e7379b8042566020 05a33587OpenDocument
What's Related
View Courses by Title
Document: Done

Course Information

Title:	**21st Century Management**
Subject:	Business - Management
*Learning Level:	22
Description:	Students will gain an understanding of leading state-of-the-art business theories and will be able to apply them to real world situations, and will learn to understand and challenge the ideas of 20th Century thinkers, and to practice developing and challenging their own theoretical thinking and applied models and paradigms Scripting and other skills tied directly to operating servers will not be covered
Keywords:	Management, 20th Century, Business Theories,
Language:	en-US
Resource Identifier(Course Code):	GMP 5012
Publisher (Institution):	Nova Southeastern University
Agent (contact):	
Click here to Contact >>	vmba@sbe.nova.edu
Location (URL):	http://www.nova.edu/
Consortium:	

Start of 54 category analysis in TeleEducation, New Brunswick database.

The TeleEducation New Brunswick survey of courses deals only with online courses.

An online course as defined by TeleEducation New Brunswick, is one that can be followed completely online. This does not mean that all course materials need to be online. Books, CD Roms, video and audio tapes, laboratory kits could be shipped out directly to students. Examinations for these online courses may be taken at local institutions or testing centres. The TeleEducation New Brunswick database excludes courses with no online component and also includes courses which require compulsory attendance at the university or training institution.

The TeleEducation course directory provides a full text search engine for users who can search by courses, or by subject categories, or by institution. A category list allows users to search by subject for example: biology, architecture, classics, computer technology. Other research features are at present in (early 2000), being built into the system, such as searching by program, by level, by country, or state or province. The aim is to keep the database as simple and useful as possible for users. The database has been built on an open architecture, so that additional fields can be added as needed. The TeleCampus online course directory provides useful analyses of the 17,000 plus courses that were in the database in the definition of online courses accepted for its survey.

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The TeleCampus online course directory only houses courses that can be taken on the Internet from anywhere with no residence requirements or need to attend sessions at a physical location. More than 17 000 courses are included in the TeleCampus Online Course Directory. These courses are delivered from more than 30 countries in over 10 languages.

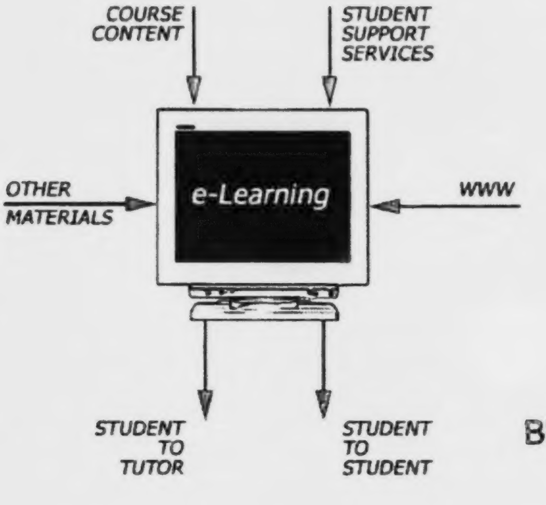
More than 90% of online courses emanate from North America. The USA dominates with more than 75% of all online courses world wide. Canada is second with 16% of online courses.. Australia, a country with a relatively small population is third with 5%. Some northern European countries like Finland, Norway and Sweden deliver many courses online, but these courses all require a residency period on site, so they are not included in the TeleCampus Online Course Directory. The Open University of Catalonia is a European leader in web-based education, but they too insist on a face-to-face component in each course, and are not included here.

The nature of eLearning

ELearning represents the awarding of nationally and internationally recognised university degrees, college diplomas or training certificates to students who spend all ion some of their study period in front of computer screens.

It might be represented diagrammatically thus:

Wired Virtual Learning Environment of Today



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In this diagram the computer screen represents the study area - the equivalent of the lecture theatre or classroom or practical training session of conventional education, or the student's home in distance education.

In the diagram course content is provided on the computer screen and student support services are provided electronically to the student in the form of electronic communication or feedback on assignments or other questioning. Access to the WWW is provided for other resources, suggested readings and library resources. Other materials can be CD Roms, floppy discs, or audio, video or paper-based resources.

In the diagram student to student communication is by emails, bulletin boards or chat rooms in which students can communicate with other students in their class or institution mainly by typed interactions. Student to tutor communication is also mainly by email, with tutor intervention in listservs a further possibility and tutor reaction to student assignments, quizzes and other forms of summative or formative evaluation.

The status of eLearning

In early 1998 newspapers worldwide carried an article claiming that 'web-based training is better than traditional training'.

Reuters had syndicated an article about the research of Professor Jerald G Schutte of the California State University on web-based training. Professor Schutte had proved, the press reported, that students on the web score 20 per cent better than students in traditional universities.

Professor Schutte reports his finding thus:

> Students in a Social Statistics course at California State University, Northridge, were randomly divided into two groups, one taught in a traditional classroom and the other taught virtually on the World Wide Web. Text, lectures and exams were standardised between the conditions. Contrary to the proposed hypotheses, quantitative results demonstrated the virtual class scored an average of 20 per cent higher than the traditional class on both examinations. (http://www.csun.edu/sociology/virexp.htm).

The syndicated report was widely used, and is often referred to, because of its striking claims.

Other claims abound:

> If the growing numbers of educators, book publishers and entrepreneurs are right, going to school will increasingly mean going online because training and education are already booming on the Web.
>
> While entertainment-oriented Web sites continue to wrestle with revenue models, educational sites are providing a familiar service, only improved by the Web's inherent advantages in terms of geography and time. Students can learn whenever they want, wherever they want, and only what they want .
> (http;//www.webreview.com/97/01/31/feature/index.html).

These presentations carry forecasts and threats that either or both conventional education and distance education is about to be swamped by web-based education. Invariably these claims show little or no familiarity with the literature, little or no familiarity with educational success or failure at a distance in the past, and little or no research to justify the claims made: but they can be highly influential.

At the time of writing it would appear that the market is still with the traditional paper- and multimedia-based distance education providers who maintain their leadership in fee-paying course enrolments. But in journal articles, conference papers and academic discussion on the web and on paper it is eLearning that is the flavour of the month and the centre of interest, with little attention being paid any longer to the field of traditional distance education.

The status of eLearning is high in corporate training and business providers like SmartForce, Cisco Systems and Click2Learn have developed a compelling presence in corporate training for eLearning.

The acceptance of eLearning

The crucial test for any dLearning or eLearning is the acceptability of qualifications at university degree won by students studying in these systems. Although the award of university degrees bor studying on the web is not yet generally acknowledged, there is a growing acceptance of web components of courses contributing to the award of a degree.

Another measure of the acceptance of eLearning is the growing availability of commercially available Learning Management Systems (LMSs) for the organisation of web-based learning. A listing provided by a Canadian website (www.c2t2.ca/landonline/evalapp0s.asp) is as follows:

WebCT Features/Tools Notes or Notes using frames

BlackBoard Features/Tools Notes or Notes using frames

Learning Space Features/Tools Notes or Notes using frames

IntraLearn Features/Tools Notes or Notes using frames

Top Class Features/Tools Notes or Notes using frames

eCollege Features/Tools Notes or Notes using frames

Click2learn ToolBook Features/Tools Notes or Notes using frames

Authorware Features/Tools Notes or Notes using frames

First Class Features/Tools Notes or Notes using frames

Docent Features/Tools Notes or Notes using frames

LearnLinc Features/Tools Notes or Notes using frames

Virtual-U Features/Tools Notes or Notes using frames

SiteScape Forum Features/Tools Notes or Notes using frames

Web Course in a Box Features/Tools Notes or Notes using frames

UniLearn Features/Tools Notes or Notes using frames

Generation 21 Features/Tools Notes or Notes using frames

Phoenix Pathlore Features/Tools Notes or Notes using frames

Saba Learning Enterprise Features/Tools Notes or Notes using frames

Pathware Features/Tools Notes or Notes using frames

Knowledgesoft Features/Tools Notes or Notes using frames

VCampus Features/Tools Notes or Notes using frames

EduSystem Features/Tools Notes or Notes using frames

Serf Features/Tools Notes or Notes using frames

LUVIT Features/Tools Notes or Notes using frames

Mentorware Features/Tools Notes or Notes using frames

The Learning Manager Features/Tools Notes or Notes using frames

QuestionMark Features/Tools Notes or Notes using frames

Eloquent Features/Tools Notes or Notes using frames

Trainersoft Features/Tools Notes or Notes using frames

WebBoard Features/Tools Notes or Notes using frames

Convene.com Features/Tools Notes or Notes using frames

Quest Features/Tools Notes or Notes using frames

PlaceWare Features/Tools Notes or Notes using frames

Embanet Features/Tools Notes or Notes using frames

OLI Features/Tools Notes or Notes using frames

Ucompass Features/Tools Notes or Notes using frames

IVLE Features/Tools Notes or Notes using frames

Integrity eLearning Features/Tools Notes or Notes using frames

InterWise Millennium Features/Tools Notes or Notes using frames

Theorix Features/Tools Notes or Notes using frames

Inspire Features/Tools Notes or Notes using frames

Jones e-education Features/Tools Notes or Notes using frames

Prometheus Features/Tools Notes or Notes using frames

Anlon Features/Tools Notes or Notes using frames

Class Act! Features/Tools Notes or Notes using frames

Colloquia Features/Tools Notes or Notes using frames

Southrock Features/Tools Notes or Notes using frames

U4all.com Features/Tools Notes or Notes using frames

Yahoo! Education Features/Tools Notes or Notes using frames

European Union documentation

European Union documentation on eLearning begins late: there is little before early 2000 as the following listing of major documents shows:

Council Resolution of 13 July 2000 on eLearning

The European eLearning Summit - (Summit Declaration)

The eLearning Action Plan - Designing tomorrow's education

The eLearning Action Plan: Guide to related programmes and instruments

Communication from the Commission eLearning - Designing tomorrow's education (May 2000)

Report from the Commission to the Council and the European Parliament "Designing tomorrow's education - Promoting innovation with new technologies" (January 2000)

Learning in the information society - Action plan for a European education initiative (1996-98)

Press Releases:

Brussels, 8 May 2001
Europe's First eLearning Summit in Brussels (10-11 May)

Brussels, 28 March 2001
Commission adopts the eLearning Action Plan to give new communication technologies a greater role in education

Brussels, 24 May 2000
Commission adopts "eLearning" to adapt our education and training systems to the knowledge economy and digital culture

Brussels, 9 March 2000
The Commission launches the "eLearning" initiative to speed up the adjustment of education and training in Europe to the digital age

It is clear that a great deal of the European Commission's interest in eLearning and the launching of its eLearning initiative is due to the recommendation of a meeting of Heads of Governments in Lisbon on 23-24 March 2000.

The Commission has adopted the "eLearning" initiative to adapt the EU's education and training systems to the knowledge economy and digital culture.

At the Lisbon European Council on 23 and 24 March 2000, the Heads of State and Government set the Union the objective of becoming "the most competitive and dynamic knowledge-driven economy in the world". Europe which, enjoys one of the highest levels of education, and has the necessary investment capacity, still lags far behind in the use of the new information and communication technologies. eLearning is designed to enable Europe to catch up by intensifying its efforts. It implements and extends into education and training the eEurope action plan, including in particular the guidelines for employment.

This initiative has four components: to equip schools with multimedia computers, to train European teachers in digital technologies, to develop European educational services and software and to speed up the networking of schools and teachers. Most of the resources to be mobilised will be national, but they should be backed by all the adequate Community instruments (the education, training and youth programmes for innovative actions and exchange of good practice, the Structural Funds for assistance in the eligible regions, the IST to support research and to promote European digital contents) and by the development of partnerships between public authorities and industry.

"Everyone in Europe will in the very near future have to come to terms with the new information and communication technologies if they are to play an active role in an increasingly knowledge-driven society" is the conclusion of the European Commission's policy document *e-Learning - Designing tomorrow's education* of 24 May 2000 (COM(2000) 318 final).

This was based on the Lisbon European Council of 23 and 24 May 2000 underlining of "the importance of acting swiftly and makes it a priority to successfully incorporate these technologies in our education and training systems". This is the challenge the eLearning initiative aims to meet.

In September 2001 the EU published a study titled *Where Is E-Learning Headed?*

Not that anyone has a crystal ball here, but educated guesses can be made about the future of e-learning, which is what this on-line article does, outlining the top ten dominant challenges and trends in e-learning -the driving forces, it says, that will influence users, vendors, and service providers in the years to come.

Here's a summary of what they are:

One, global interest is growing in e-learning. Prediction - 80 percent of the top U.S. and European universities will offer global courses by 2004.

Two, national, state, and local governments will be investing more and more. While, on the one hand, in underdeveloped countries, e-learning can raise the level of education, literacy, and economic development, on the other, in public services, e-learning will help in developing or supplementing skills and practices in areas such as health, medical, and agriculture.

Three, technology will have to offer easier implementation, lower cost per unit, and better content. Part of meeting these challenges and overcoming these obstacles will be a parallel rise in demand for people who can develop diverse courseware that is multilingual, addresses various topics, and takes advantage of Web functionality. Indeed, estimates are that by 2005, one of the top 10 most in-demand positions among Global 1000 companies will be online learning designers.

Four, hosted e-learning will offer alternative infrastructure. Since companies need ways to meet their immediate, tactical training and reskilling needs, hosted e-learning can offer an alternative to meet those needs, letting companies focus on strategic development instead.

Five, business-to-employee initiatives will address e-learning for recruiting, retention, and employee-relationship management.

Six, collaboration and extended enterprises will expand the employee base by providing delivery and access for every key and enterprise.

Seven, e-learning will also extend to customers, customers who will be looking for diverse kinds of value-added services. By 2005, the report says, e-learning will be an accepted practice on 70 percent of customer Web sites.

Eight, simulation, gaming, and interactivity will enrich e-learning, given that studies show that learning by experience improves learner's retention and understanding. Therefore, technologies such as collaboration, interactivity, modeling, simulations, virtual reality interfaces, and gaming will help students experience the skill being taught.

Nine, wireless e-learning will be adopted where no wires exist and may become the lowest cost for networking.

And, finally, ten: there will never be enough of the "right" skills. Not just employees but also businesses will use e-learning to reskill and keep pace with the fast-changing technological and business world.

The arrival of mLearning

In the short space of time between 1995 and 2000 eLearning became the state of the art for the use of technology in education. Many predicted that it was the final solution for corporate training and university programmes alike.

But by 2000 wired telephones and wired computers were beginning to be replaced by wireless ones. This has important didactic dimensions as it frees the learner, who may have spent much of his or her working day in front of a wired computer, from studying in front of a computer screen too. Although there is much evidence from eLearning research of the interactive value of emailing, the validity of typed interactions for learning purposes can be questioned when compared with spoken interaction.

From dimensions such as these came the birth of mLearning, the provision of learning on wireless and mobile devices.

CHAPTER 4 MLEARNING INITIATIVES TODAY

In this chapter 30 mobile learning initiatives today are presented and analysed. They give the background and context to the sector and demonstrate the growing importance of mLearning as a field of educational research and endeavour.

The first grouping is of mLearning initiatives undertaken to provide course materials on mobile devices, usually PDAs and palmtops, and rarely mobile telephones. These are followed by two mobile learning portals: the mLearning Forum and Eclipse.

These are followed by details of international conferences because it is at conferences that the strength and vitality of new innovative educational initiatives can best be gauged. The selections conclude with three attempts, by Sariola in Finland and Nyiri in Hungary and Ring in Singapore, to provide theoretical and analytical constructs for the field.

1. Mobilearn www.viktoria.se/~lundin/mobilearn

There are three projects on mobile learning using the title Mobilearn: one, based at the Viktoria Institute at Gothenburg in Sweden is described here; another, a German/Brasilian partnership is presented in section 2 below. The third, an Italian-led project funded by the European Commission's IST programme, is detailed in section 3.

The partners in the Viktoria Institute Mobilearn project are:

- Viktoria Institute, Gothenburg
- Ericsson Radio Systems AB
- ADB-Kontaret, Gothenburg
- Ericsson Microwave Systems AB.

In an article titled 'Mobilearn: competence development for nomads' the aims of the project are presented:

> Organizations in the *new economy* are dependent on organizational knowledge and competence. Workers in these organizations are to a large extent mobile. They need new competence development opportunities unrestrained by time and space. We have developed and successfully tested models, applications and activities (e.g. *multimedia scenarios*) supporting competence development. We are transferring this competence development activity to mobile settings to achieve successful competence development for nomads. The goal is identifying applications and services in the competence development realm suitable for 3G (third generation cellular networks). Combining our models and activities with the new technology we rethink how competence development can be conducted and managed.

To be able to redesign and evaluate multimedia scenarios on handheld devices the project used Compaq iPAQs Pocket PC and Sony VAIO C1 Picturebook. iPAQs were used for simulation of the expected small screens of the 3G – terminals. The Vaio (small size, built in video camera) is excellent for testing videoconference with a wireless LAN (simulating future 3G networks).

In another article 'Mobile competence development for nomads' it is stated that the project is attempting to create a human-computer environment on handheld devices that encourages and simplifies communication between groups as well as having support for educational models in order to facilitate collaborative learning. The project is based on the availability of 3G technologies for transferring already existing multimedia scenarios for collaborative learning to mobile multimedia scenarios.

Here is a multimedia scenario proposed by the project:

Jack is traveling by train to meet a customer. He has to get prepared for the meeting but after reading through the background material of the customer he has time to engage in some 3G competence development. He connects to the e-business education that started this week, and views a short video that introduces the first week's topic (see Figure).

The video raises some interesting points. Jack is especially interested in the point about customer relations' management (CRM). He decides to initiate a videoconference with a colleague in his group to discuss the issue right away. The 3G platform indicates that his colleague will accept incoming videoconference calls related to the e-business education. Jack makes the call and they talk for five minutes and reach the opinion that CRM seems to be a fad. Jack decides to share their thoughts with the rest of the group and posts a short written message in the common discussion area.

The objectives of this project are given as:

It is often difficult for mobile people to allocate time for educational and training activities, as well as coordinating their mobility so that they can network with colleagues in person. Hence, traditional lecture-oriented courses are not considered as viable. Mobile workers and their organizations request alternative educational and knowledge development opportunities. They have special prerequisites concerning competence development and construction of knowledge.

Based on previous research we now are making a transfer to new applications and models, which allow mobile people to engage in genuine interaction in competence development activities. Our main goal is to: understand the competence development needs of nomads and to support these needs with 3G or other wireless solutions as the platform. We want to explore learning models, applications for mobile competence development as well as business models for the mobile competence development.

The project's use of the English word 'nomads' for 'mobile workers' or 'mobile people' seems unfortunate as the English word is not usually regarded as synonymous with the other concepts.

2. MobiLearn: Mobile Computing in Learning Environments

www.dca.fee.unicamp.br/projects/Mobilearn

This is a project in mobile computing funded by the German DAAD (Deutscher Akademischer Austauschdienst) and the Brasilian CAPES (Fundacao Coordenacao de Aperfeicoaments de Pessoal de Nivel Superior).

There are two partners:

- Technische Universitat Darmstadt, Darmstadt, Germany
- Universidade Estadual de Campinas, Campinas, Brasil.

The aim is to enable students to interact through a computer-supported learning environment not just from conventional desktop computers, connected to high-speed networks, but also from mobile terminals with low-speed wireless connections.

The project started on 1 January 1999 and ended on 31 December 2000.

The technological goal of the project is to develop and to study forms of integrating appropriate mobile computing capabilities into computer-supported learning environments. The project intends to evaluate the effectiveness of portable computers (such as light-weight notepads and laptops), connected to information servers, either through a terrestrial network or through lowspeed wireless connections, as delivery terminals for courses with multimedia and hypermediacontents.

It intends to exploit the adaptability of multimedia and hypermedia information (*e.g.*, the form of presenting the content material, user interactivity, and information structuring) to the resources available at the user terminals and to the communication network conditions.

The project plan is to apply intelligent mobile agents in order to offer a context-sensitive resource utilization and suitable data access within the learning environment.

3. Mobilearn. Giunti Ricerca IST project. www.mobilearn.org

This is a project funded by the European Commission's IST programme. The full title of the project is: *Next-generation paradigms and interfaces for technology supported learning in a mobile environment exploring the potential of ambient intelligence.*

A summary of the project states:

This project explores new ways to use mobile environments to meet the needs of learners, working by themselves and with others. State-of-the-art mobile devices will be available. A new m-learning architecture will support creation, brokerage, delivery and tracking of learning and information contents, using ambient intelligence, location-dependence, personalization, multimedia, instant messaging (text, video) and distributed databases. Field trials cover "blended learning" (as part of formal courses); "adventitious, location-dependent learning" (during visits to museums); and "learning to interpret information sources and advice" (acquiring medical information for everyday needs). The high connectivity and functionality may lead to new group behaviours, akin to the SMS phenomenon. The economic benefits of this project will be substantial at European level, and will be realised quickly because of the involvement of key actors. These include public bodies, mobile operators, software and learning technologies production companies, mobile devices manufacturers, publishers and content providers, and participants in standards initiatives.

The list of partners is impressive:

University of Birmingham (UK)
Open University (UK)
University of Tampere (FI)
Università Cattolica del Sacro Cuore (I)
University of Koblenz-Landau (D)
University of Zurich (CH)
Stanford University (USA)
MIT OKI (USA)
University of Southern Queensland (Australia)
Education.au Ltd (Australia)
NOKIA Corporation (FI)
Deutche Telekom (D)
Telecom Italia (I)
Telefónica I+D (SP)
COSMOTE (GR)
SPACE HELLAS (GR)
Emblaze Systems (IL)
Fraunhofer IFF (D)
SFERA ENEL (I)
University for Industry (UK)
Liverpool John Moores University (UK)
Sheffield Hallam University (UK)
Peter J. Bates Associates (UK)

COMPAQ Computer (I)

There is also a project special interest group:

Firenze Musei, ALMA WEB, Delft Technical University of Technology, CISCO, ERIKSSON, European Resuscitation Council, British Telecom, KPN, ORANGE UK, VODAFONE, Northwestern University, University of Essex.

Nine European countries are involved and countries outside EU, including USA and Australia. The project co-ordinator is Giorgio Da Bormida of GIUNTI Ricerca (Italy). The total cost of the project is □7.505.312 of which the European Commission's contribution is □3.505.385.

The project is described as follows:

The integration of new technologies (e.g., personalization, multimedia, ambient intelligence, haptic interactions, mobile devices) in education and training is basically a culturally driven process with the need to bring about change not only in people, but in the entire learning environment. This is a key part of the MOBIlearn project. The need for this element in projects has now been recognised in the new eLearning Action Plan [ELE-AP]. This is a part of the comprehensive eEurope Action Plan [E-EUROPE] for European uptake of digital technologies, in which a basic objective is for education systems to use developments in information and communication technology (ICT). Another important part of the MOBIlearn project is the free circulation of knowledge, in forms that are appropriate for individual users. In the last decades political and social progresses have underlined the importance of the free circulation of knowledge as the most advanced answer to the increasing needs of new skills related to new technologies and new socio-economic models brought by the Information Society. On the basis of these considerations, the Amsterdam and Lisbon European Councils [LISBONCO] outlined the strategic policy framework for promoting new methods and technologies and for an effective spreading of knowledge across Europe, aiming to become, in the next decade, the world's most important knowledge-based economy [E-EUROPE]. The recent "*e-mobility 2001 EU Information Society*" International Conference on mobility in the Knowledge Economy [E-MOBILITY], convened in Goteborg in preparation for the European Council, highlighted priorities we shall explore: the need to define new working paradigms (e.g. mobile worker) together with innovative models for their social, economical, cultural and environmental deployment, also preserving the local nature of content (national and regional) and cultural heritage. In the same event it emerged that the sustainable social and economic deployment of such models within the Information Society of the third millennium will see a key role of new technologies for mobile access to knowledge.

On these social and technological premises, the MOBIlearn project aims at improving access to knowledge for selected target users (such as mobile workers and learning citizens), giving them ubiquitous access to appropriate (contextualised and personalised) learning objects, by linking to the Internet via mobile connections and devices, according to innovative paradigms and interfaces.

The Goteborg Conference also underlined the need for pilot experimentations and applications for the fast spread and uptake of envisaged models and related services to preserve Europe's leadership in the exploitation and innovation of mobile technologies. The need for this is becoming urgent. For example, the CEO of a leading North American company, dominant in its areas of operation (e.g., operating systems) said that it also intended to become the global market leader in mobile computing, at the expense of some European companies, involved in this project.

So the MOBIlearn project is justified in two ways: its pioneering RTD directly targets priority areas for the knowledge society, and its exploitation directly addresses the need for Europe to stay dominant in the important area of mobile applications. To deliver these crucial results, the MOBIlearn project will exploit a partnership that is truly international (partners coming from nine European countries and countries outside EU, including the USA and Australia), capable and influential. The partnership includes well-known Universities and public bodies with a large user-base, mobile operators of five countries, leading European software and learning technologies production companies, World-class mobile devices manufacturers, market analysis consultants, publishers and content providers. Those partners bring a real cross-disciplinary know-how, with expertise in pedagogy, adaptive interfaces, collaborative learning, context awareness, business modelling and e-learning technologies.

The scope of the MOBIlearn project is ambitious but within the capabilities of the partnership. The scope includes studies of conceptual models and new methodologies, with prototypes implementing them. These will be evaluated in trial application fields set up and managed by international partners participating within the MOBIlearn project. The project will focus, in fact, on the target markets (individuals or small groups of people spread Europe-wide in many and various sites, willing to access knowledge on demand, just in time and in the field to foster their life long learning and enhance their working experience). The final objective is to improve the knowledge level of individuals through cost and time optimisation of learning processes. This maximises the opportunities of three representative groups:

- Workers, to meet their job requirements and to update their knowledge continually;
- Citizens as members of a culture, to improve the learning experience while visiting a cultural city and its museums;
- Citizens as family members, to have simple medical information for everyday needs.

The MOBIlearn system will allow acquisition of ways to meet user needs and build knowledge spaces. Impacts of the solution on self-learning will be explored in three selected and very representative applications for mobile learning (m-learning), namely:

- Master in Business Administration (MBA) schools, where international MBA institutes (*partners of MOBIlearn*) will extend the reach and scope of their current blended-learning offering, by providing learners with personalised and tailored subscriptions to content on mobile networks;

- A European city famous worldwide for its art (Florence), where Firenze Musei (*not a partner, but a member of the MOBIlearn Special Interest Users' Group*), a consortium managing all the European historical and cultural heritage locations of the city, will improve its offerings enabling learning citizens to access context sensitive art, historical & cultural knowledge with mobile devices while visiting museums and galleries;
- Access to basic medical knowledge to enable support for anywhere and anytime interventions. The certified knowledge basis is provided by the European Resuscitation Council (*not a partner, but a member of the MOBIlearn Special Interest Users' Group*), which already trains non-specialised citizens in basic medical procedures (such as Basic Life Support), with quick reference, audiovisual procedural guides and VR simulations.

Nevertheless the solution could be applied in many other business sectors and knowledge domains and applications for many kinds of learning and many circumstances and areas. The MOBIlearn project contributes to breaking traditional barriers to learning for many people, which exist for them now due to their limited access to information, limited time for learning and isolated environment. It should be borne in mind that these application areas are selected to provide a diverse set of user requirements and technical challenges, to draw upon previous EU-funded projects, and to allow consideration of a broad range of user activities.

The MOBIlearn project has international relevance by proposing the conception, population and experimentation and exploitation of new models of learning and information use, via next-generation mobile networks, through:

- creation of pedagogical paradigms to support learning in a mobile environment (such as collaborative learning, organisational learning, dynamic knowledge creation in a group);
- new architectural layouts to support creation, brokerage, delivery and tracking of learning and information contents on the mobile network, which extend existing systems;
- selection and adaptation of existing eLearning contents for mobile devices, enabling automatic multi channel and multi device versioning;
- realization of new business models, based on existing success-cases (e.g. DoCoMo iMode), for the self sustainability and deployment of the conceived solutions beyond the research timeframe within Europe's Knowledge Society framework for the third Millennium.

The goal of the MOBIlearn project is the creation of a virtual network for the diffusion of knowledge and learning via a mobile environment where, through common themes, it is possible to demonstrate the convergence and merging of learning supported by new technology, knowledge management, and new forms of mobile communication. This also creates a virtual point of mobile access to content that could be used at a European and International level. A subsidiary goal is to develop deeper understandings of the social processes and interactions that arise when connectivity reaches a critical point, so that we are alert to the possible emergence of "ambient intelligence" equivalents of the widespread take-up by users of SMS.

The objectives and scope of the MOBIlearn project appear to be very challenging, yet achievable thanks to the multi facet and innovative layout of the proposed architecture and model specifically addressing the variety of pedagogical, social and working contexts that a typical European mobile worker and learning citizen might experience.

The project quotes a European Commission report *Scenarios for Ambient Intelligence in 2010* [AMBINT]:

> "*The concept of Ambient Intelligence (AmI) provides a vision of the Information Society where the emphasis is on greater user-friendliness, more efficient services support, user-empowerment, and support for human interactions. People are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects and an environment that is capable of recognizing and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way.*"

MOBIlearn is conceived a first step in the direction of this "year 2010" scenarios, exploring, in a pioneering way new forms of interaction and ubiquitous computing and learning, considering that FP6 should not just extend current approaches to R&D, but look beyond current paradigms for e-learning, developing applications in which any appropriate technology is used to place the learner at the centre of a user-driven process.

4. mLearning IST project (LSDA)

www.ultralab.ac.uk/projects/m-Learning/

mLearning is a European Commission IST m-learning project addressing social and educational problems in young adults.

The m-learning project addresses 3 social/educational problems relating to many young adults in the EU:

- Poor literacy/numeracy - see e.g. Improving Literacy and Numeracy: A Fresh Start
- Non participation in conventional education/training
- Lack of access creating ICT "haves"/ "have nots" resulting in inequality of opportunity

m-learning will develop prototype products to provide information and modules of learning via inexpensive portable technologies which are already owned by, or readily accessible for, the majority of EU young adults.
The design of the prototypes will be informed by research including:

- Research into the use of mobile phone technology: needs, preferences, attitudes and habits of young adult mobile phone users.
- Research into computer game design and their users' preferences.
- Research and development seeking appropriate knowledge representation, learner models and standards, including metadata standards to provide a framework for development and description which can be practically applied to very small modules of basic skills learning delivered via mobile communications technologies.

Description of the work

Research elements of m-learning will include:

1.An analysis of current standards in the field of learning object representation to inform development of an intelligent tutor and to inform development workpackage managers' decisions as to appropriate standards to apply.

2.An initial investigation followed by a continuously updated technology watch service toidentify, review and select from current and emerging mobile communications technologiesthose with potential for use as delivery vehicles for m-learning information and learning modules, taking into account medical research into possible health hazards associated with excessive use of mobile phones.

3.A survey of young adults use of mobile technologies exploring needs, preferences, attitudes, habits and experiences. Followed by research focussing on the potential of-learning for specific groups e.g. those with sensory impairments.

4.Research into the use of computer games consoles by young adults

5.Work with groups of learners to identify design approaches for internet micro portal user interfaces to m-learning modules which will encourage independent exploration of on-line resources and empower learners to exercise choice whilst facilitating ease of use and making m-learning enjoyable.

6.Initial and on-going desk research to identify other relevant research projects which might inform m-learning developments. Development work with m-learning will include:

7.Design, development and trialing of a prototype multi-agent "intelligent" tutor system to evaluate learner knowledge and preferred learning styles/strategies and assist with personal development planning including tailoring of micro-courses to suit individual needs.

8.Design, development and trialing of prototype multimedia modules, incorporating speech technology functionality , for use via mobile technologies to deliver aspects of literacy and numeracy skills learning. Incorporating advanced speech and languages technologies functionality to maximise the potential of handheld devices.

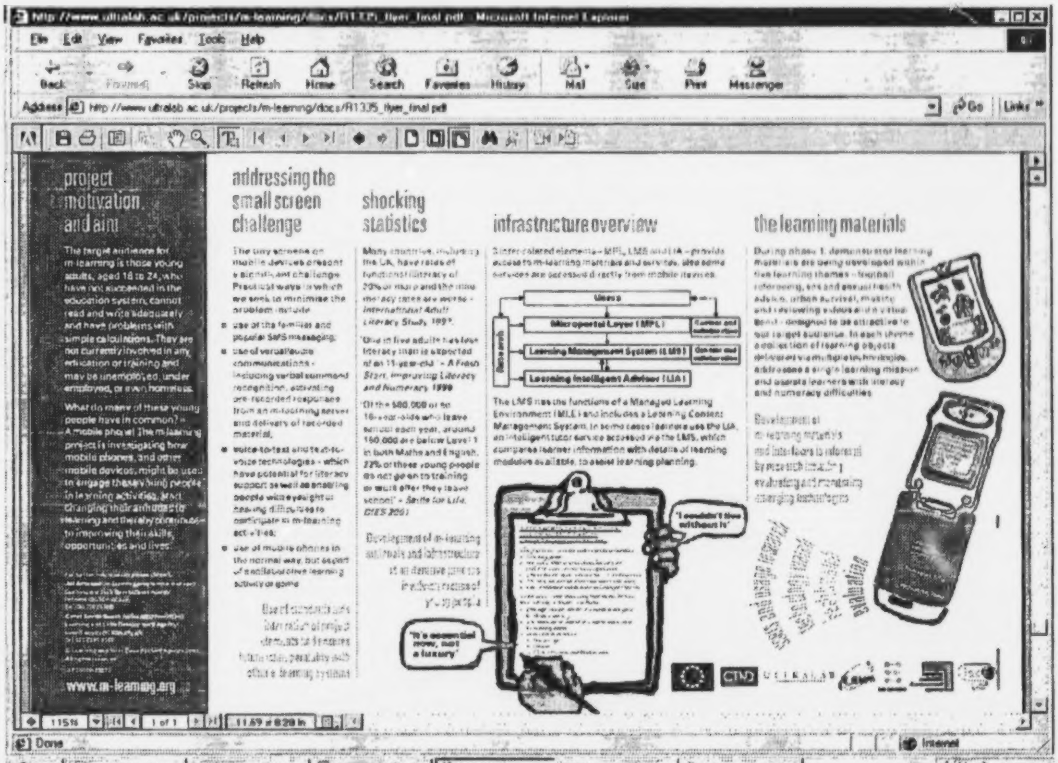
9.Development of microportals and interfaces tailored to the needs of specific groups of users within m-learning's target audiences and to different levels of technological sophistication in the handheld devices used.

10.Translation of prototypes and microportals developed to achieve both English and Italian versions.

Milestones and expected results

It is expected that commercial m-learning products will be developed based on the prototype literacy and numeracy modules and microportals developed by this project. The capability of mobile communications devices to deliver aspects of learning, and the design principles which motivate users to use such devices, will have been investigated and assessed.

The project is presented thus:



Address http://www.ultralab.ac.uk/projects/m-learning/docs/R1335_flyer_final.pdf

project motivation and aim

The target audience for m-learning is those young adults, aged 16 to 24, who have not succeeded in the education system, cannot read and write adequately and have problems with simple calculations. They are not currently involved in any education or training and may be unemployed, under employed, or even homeless.

What do many of these young people have in common? – A mobile phone! The m-learning project is investigating how mobile phones, and other mobile devices, might be used to engage these young people in learning activities, and changing their attitudes to learning and thereby contribute to improving their skills, opportunities and lives.

www.m-learning.org

addressing the small screen challenge

shocking statistics

infrastructure overview

The LMS has the functions of a Managed Learning Environment (MLE) and includes a Learning Content Management System. In some cases learners use the LIA, an intelligent tutor service accessed via the LMS, which compares learner information with details of learning modules available, to assist learning planning.

the learning materials

Users
Microportal Layer (MPL)
Learning Management System (LMS)
Learning Intelligent Advisor (LIA)
Research
"It's essential now, not a luxury"
"I couldn't live without it"
Done
Internet
Start
12:33 PM

m-Learning is a □4.5m 3 year pan-European research and development programme supported by the European Commission's Information Society Technologies (IST) programme within the 5th framework.

BEST COPY AVAILABLE

The programme is co-ordinated by Learning and Skills Development Agency (LSDA) and participant organisations include universities and commercial companies based in three EU countries - Britain, Italy and Sweden. m-learning's aim is to develop prototype products and services which will deliver information and learning experiences via technologies that are inexpensive, portable and accessible to the majority of EU citizens.

The products and services in development are designed to capture the interest of young adults (16 to 24) who are not currently taking part in education or training and to assist them in the development of life long learning objectives. The learning themes focus on subjects of interest to young adults, e.g. football and music, and the modules include activities designed to develop aspects of literacy and numeracy. m-learning's target audience includes young adults who are unemployed, under-employed or homeless.

m-learning infrastructure includes a Learning Management System which, together with the microportal interface layer under development, will facilitate access to m-learning materials and services from a variety of mobile devices plus web and TV access. For interfacing with devices with minimum multimedia functionality, and for the benefit of learners with sensory difficulties, m-learning is developing speech-to-text, text-to-speech and SMS facilities. Support for collaborative learning and peer-to-peer interaction is also being developed. Development of the microportal layer is an iterative process informed by work with groups of young adults.

Participants

Co-ordinating Partner is The Learning and Skills Development Agency (LSDA) whose office is at Citadel Place, Tinworth Street, Vauxhall, London SE11 5EH, UK.

Other partners are:

CRMPA (Principal Contractor), Via Ponte don Mellillo, 84084, Fisciano, (Salerno), Italy
CTAD (Principal Contractor), Lincoln House, The Paddocks, 347 Cherry, Hinton Road, Cambridge, CB1 8DH
The Learning Kernel (TLK) (Assistant Contractor), Sint-Krispijnstraat 7, 8900 IEPER, Belgium
Ultralab at Anglia Polytechnic University (Principal Contractor), Victoria Road South, Chelmsford, CM1 1LL

Total project funding is □4.500.00.

5. Telenor mLearning Wap project www.insiteint.com/e3g/

The project was run in Norway in spring 2001 with four partners:

- Ericsson

- Insite
- Telenor Mobil
- IT Fornebu Knowation (project leader).

The project report, written by Tove Kristiansen of IT Fornebu Knowation is divided into four parts:

- International trends
- Project description
- The pilot course
- User experiences.

The project gives a definition of mLearning: the use of mobile terminals in learning and attributes its growth to an in creasing mobility and the growing need for flexible learning.

International trends

Details are given of the expected growth of both eLearning and mLearning with a quotation from Brandon Hall 'I have the sense when I look at the Palm VII or a wireless phone that I am staring at the future'.

Project description

The aim of the project was to use some simple WAP solutions as an add-on to an ordinary course given in a classroom.

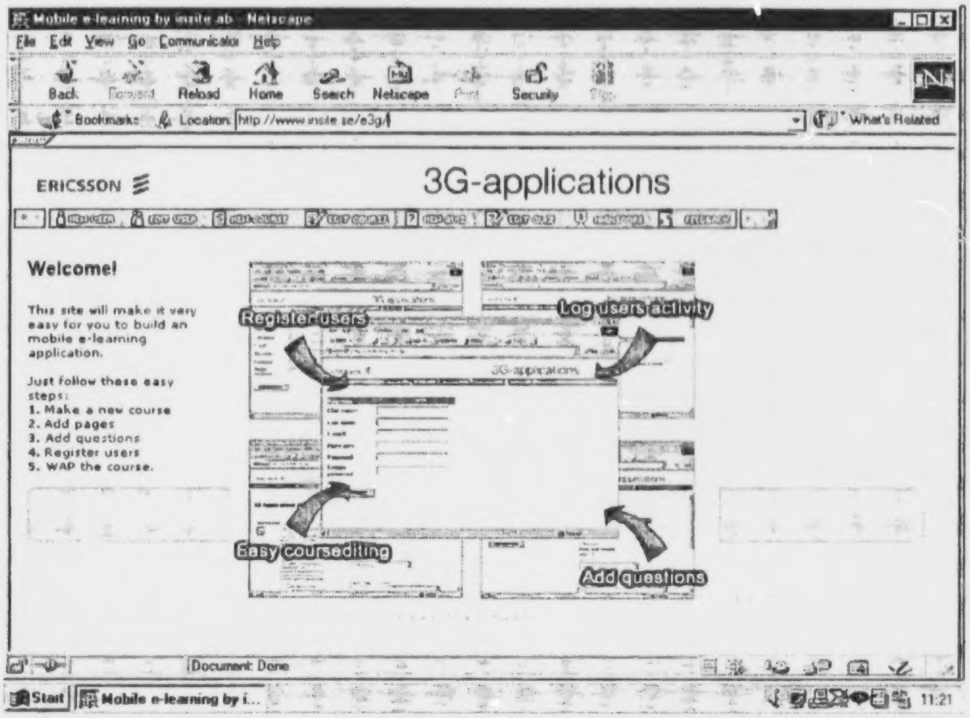
The course was an Ericsson course *Introduction to 3G applications* which focuses on UMTS technology and future applications and services.

All the 18 participants were employees of Telenor Mobil and each was given an Ericsson R380 WAP phone to use during the course.

The phones were used for demonstrating future services, repetition, a quiz, an idea box and course evaluation.

Future services were demonstrated by getting each participant to order their lunch via WAP from a local hotel. Repetition was for the revision of certain parts of the course outside the course hours. In the quiz a total of 18 statements were given and the participants had to answer 'true' or 'false' and submit their answers. Each person could immediately see their scores, and the scores of the other participants for comparison. The idea box was set up to allow participants to write down their thoughts about the mobile internet and the potentials of mLearning. In the course evaluation the participants were asked to fill in and submit the questionnaire. The course organizer could then read the evaluations immediately on the World Wide Web.

The tool for creating the course for WAP-telephones is presented thus at http://www.insiteint.com/e3g:


Mobile e-learning by insite ab - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Stop
Bookmarks Location: http://www.insite.se/e3g/
What's Related
ERICSSON
3G-applications
Register users
Log users activity
Easy coursediting
Add questions
Document: Done
Start
Mobile e-learning by i...
11:21

Welcome!

This site will make it very easy for you to build an mobile e-learning application.

Just follow these easy steps:
1. Make a new course
2. Add pages
3. Add questions
4. Register users
5. WAP the course.

User experiences

The overall impression was that the participants experienced the use of WAP telephones as a very positive supplement to the course. The possibility of revision while going back home at night was rated highly. The immediate feed-back to the quiz and the ability to do it anywhere and anytime were also appreciated.

In conclusion, Kristiansen writes·

> The potential for improvements is obvious. When broadband multimedia becomes accessible and mobile terminals get larger colour screens within a few years, there will be no limitations as to what kind of content is will be possible to provide. Thus, the challenge for further development of mLearning lies more within pedagogical and organisational aspects than with technological ones.

6. UniWap (University of Helsinki/ICL)
http://ok.helsinki.fi/sivut/inenglish/background.html

The aim of the UniWap project is to develop educational use of mobile technology and to find out pedagogical applications to be of benefit in the virtual university. The project deals with the WAP technology to be tested, piloted and completed in order to facilitate teaching and learning in the university. An environment of activities will be developed in order to provide

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services for flexible learning and to discover new forms of publishing of learning material.

The UniWap project is a joint venture of the Helsinki University and ICL Invia. The mCastor technology has an essential role in the project. This technology enables the user, who may have several terminals like WAP, PC or Communicator, to use the same information service or system adapted to the actual user environment.

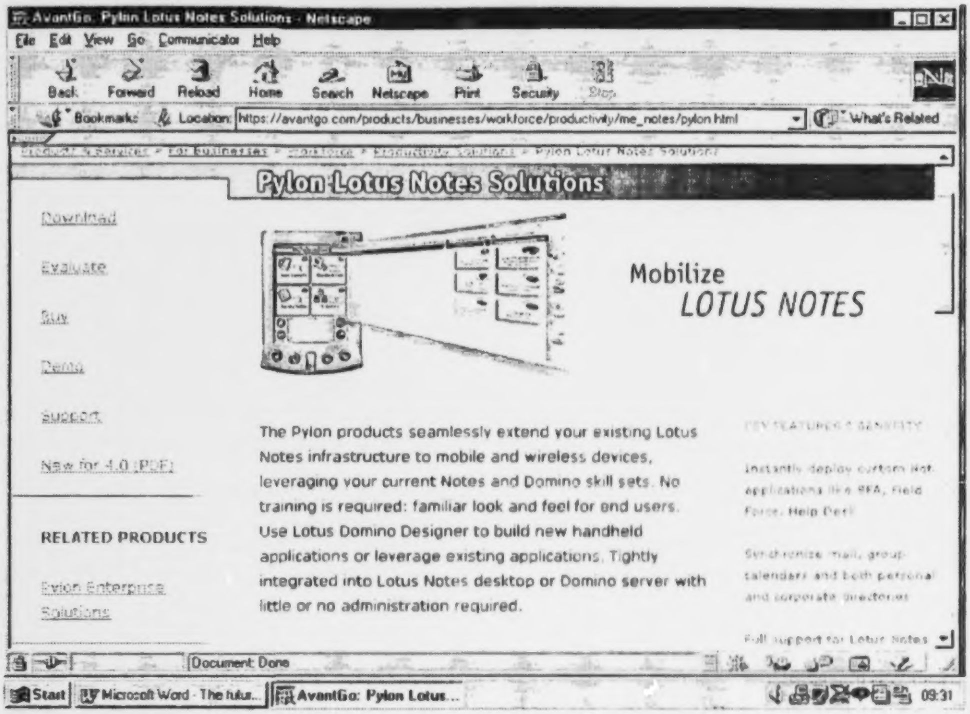
The First Stage
The first stage of the project will concentrate on discovering new ideas and pedagogical applications in which mobility could be of benefit in the in-service education of university teachers.

The Second Stage
At the second stage, the Educational Centre for ICT will support departments and multi-disciplinary research groups by training and consulting. The centre will make efforts to network different academic fields together in order to create collaborative development projects during 2001 to 2002. Also contacts to companies will be fostered in this process. The companies will provide the project with equipment, software and information systems.

The Third Stage
The third stage focuses on diffusion of innovation by training and commofidication throughout the Helsinki University and, perhaps, to be also used in the Finnish Virtual University.

7. AvantGo http://avantgo.com

AvantGo is a producer of mBusiness products for palmtops and pocket pcs. Here is their presentation of their product for producing a mobile version of Lotus Notes.


AvantGo: Pylon Lotus Notes Solutions - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Stop
Bookmarks Location: https://avantgo.com/products/businesses/workforce/productivity/me_notes/pylon.html
What's Related
Products & Services > For Businesses > Workforce > Productivity Solutions > Pylon Lotus Notes Solutions
Download
Evaluate
Buy
Demo
Support
New for 4.0 (PDF)
Pylon Enterprise Solutions
Document: Done
Start
Microsoft Word - The futu...
AvantGo: Pylon Lotus...
09:31

Pylon Lotus Notes Solutions

Mobilize
LOTUS NOTES

The Pylon products seamlessly extend your existing Lotus Notes infrastructure to mobile and wireless devices, leveraging your current Notes and Domino skill sets. No training is required: familiar look and feel for end users. Use Lotus Domino Designer to build new handheld applications or leverage existing applications. Tightly integrated into Lotus Notes desktop or Domino server with little or no administration required.

KEY FEATURES & BENEFITS

Instantly deploy custom Hot applications like SFA, Field Force, Help Desk

Synchronize mail, group calendars and both personal and corporate directories

Full support for Lotus Notes

RELATED PRODUCTS

8. Ibrite http://www.ibrite.com

IBrite has developed an authoring product for putting content together for the Palm PC.

Together with Global Knowledge, the leading US IT training provider, it has developed two courses for the PC Palm, Telecommunications Fundamentals 1 and Telecommunications /fundamentals 2. Both of these courses are offered by Global Knowledge as classroom offerings but these new developments as PalmOS software enable the courses to be taken at any time anywhere.

Telecommunications Fundamentals 1 is 9 chapters long and has 48 graphics which work on colour and black and white Palms. It has 417 pages of text.

Telecommujnications Fundamentals 2 is also 9 chapters long and has 65 graphics, both for colour and black and white Palms. It has 524 pages of text. Ademo version of 1 chapter, 34 pages and 6 graphics can be down loaded from http://www.ibrite.com/download_software.htm.

9. Isopia (now part of Sun)

Isopia provides this definition of mLearning: 'With the power and functionality of Sun LearnTone LMS extended to mobile devices, Sun enables enterprises

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to offer a seamless, blended learning experience extending from classrooms and desktops, to PDAs, two-way pagers, mobile phones and hybrid devices'.

It claims that mobile learning or mLearning, is resulting in a paradigm shift in the way people learn. Learning has moved from the classroom, onto your desktop and with mlearning, into your pocket. Acknowledged by industry experts for its superior standards-based technology platform, Sun LearnTone LMS is the only eLearning infrastructure in the marketplace that offers both eLearning and mLearning capabilities delivered entirely using Java.

On 29 March 2001 Isopia announced that anytime, anywhere learning materializes with courses available on PDAs, cell phones, and handheld devices. With oibkly a cell phone, hand-held device, Personal Digital Assistant or hybrid unit (combination cell/PDA) users can access administrative functions, download courses, and review their learning history through Isopia's Integrated Learning Management System (ILMS) or Learn Tone.

The mLearning solution is designed for flexibility, incorporating Sun Microsystem's Java 2 Micro Edition (J2ME). Unlike the Wireless Application Protocol (WAP) and Wireless Markup Language (WML), J2ME enables the user to take courses without being connected to the network. It also supports more complex courseware than the standard wireless protocol.

Isopia's mLearning solution allows the user to upload the mobile course edition from the online learning path, whether connected to or disconnected from the internet, and take courses on any device, then upoload information about their course progress and test scores to the ILMS the next time they reconnect to the network.
Isopia presents the following scenario:

You are checking in at the airport. The line is long - So how do fill your time? Before leaving for the airport you had downloaded a course on your PDA from your computer at the office. In the line-up, you now pull out your PDA and decide to brush up your knowledge on your company's latest product offerings. At the end of this course you take a short quiz to test your knowledge.

When you arrive at your destination, you check into your hotel room and set up your laptop. Setting your PDA into its cradle, you link up to your learning portal through the Internet. You connect- "hot-synch"-directly with your company's learning management system, ILMS™, which will read the results of your completed courses and automatically update your learner profile. You then decide to download a number of reference materials and courses for study on the road and at home.

In this real-life scenario, as you synchronize your device using a wireless or wireline connection, the latest mobile versions of designated courses are loaded from Sun LearnTone LMS onto your device. You are then free to take the courses or manage your training at leisure when disconnected from the network. The next time you connect to your learning environment to synchronize the information on your device, all the course progress and assessment scores are passed to the Learning Management System, updating your profile.

On 19 June 2001 Sun Microsystems bought Isopia and integrated it into its education division. There does not seem to be a link from the Sun home pages to the Isopia material.

10. Experient www.experientcorp.com

Experient.com have published a white paper titled *Mobile eLearning Systems* which promotes its Calypso product. Calypso enhances current technologies, it is said, that do not adequately exploit the potential of the internet for learning. Calypso allows learning any time, any place, any where without constant access to, or persistent use of, the internet.

The system is designed to run on virtually any platform and bring the power of web-based eLearning to the learner in either online or offline mode, with the advantage of offline tracking. One connects to the internet only long enough to download the web-based courses from the central server of learning management system. Then, one disconnects and the system gives one complete browser functionality, along with learning aids, progress checks, and testing features all the actions are stored for later retrieval.

The basis of the mobile eLearning system is Calypso, a 100% Java-based application built by Experient Technologies. Calypso is a software engine designed to manage both the deployment and retrieval of distributed, rapidly changing data and functionality across differing client hardware including wireless. it can run on handhelds using Windows CE and PalmOS devices.

Calypso provides the Mobile eLearning System with a robust database for gathering data on learners whether a network connection is maintained or not. Once the learner goes online, the Mobile eLearning System automatically synchronizes the learner with the central LMS and an asynchronous exchange of data takes place. At the same time as the learner is receiving automatic eLearning updates, the data is collected on the learner and transmitted to the main LMS.

The Java-based Calypso product is built in 5 layers: user interface layer; content layer - for the course content; toolkit layer - including testing, studying and scoring; network layer - for connectivity; engine layer - provides a single interface to information so that other layers can read from or write to the internet of the computer.

LearnSomething.com, Inc, a leading developer of customized web-based continuing education programmes, and Experient have agreed to integrate LearnSomething's ASP-based learning management system with Experient's mobile learning access technology. Clients and partners of both companies will be able to create and download complete Web-enabled courses to a variety of mobile devices, such as laptop computers, pocket PCs, PDAs and other hand-held equipment. Learners will be able to complete those courses offline using their browser features. The software allows for comprehensive testing and offline tracking, enabling a complete, efficient, and mobile learning management solution.

11. INSEAD/Nokia/ICUS

www.learningcircuits.com/2001/jul 2001/ring.html

INSEAD, NOKIA, and ICUS formed an Asia-Pacific consortium to pilot m-learning. The initial result of their endeavor was the development and deployment of an e-course delivered via WAP-enabled NOKIA phones. The course, *eBusiness on the Move*, was developed to make use of both WAP (wireless) and Web (wired) technologies, allowing participants to access content via phone and computer.

Evaluations tracking learner progress revealed that WAP technology delivered an average level of coaching support and higher than average level of technical support.

Based on an INSEAD classroom course, *eBusiness on the Move* offered an introductory look at current and future use of the Internet in business,

Learning activities comprised reading material, bulletin board discussions, multiple-choice quizzes, and writing assignments. Learners linked to video clips, PDFarticles, and Websites. In addition, the course required two coaches to facilitate and track learner progress. For example, one coach provided feedback on an interactive bulletin board while the other coach used email to provide direct assistance to learners about course content and procedural matters. There was significant peer-to-peer and peer-to-coach interaction via bulletin boards, direct email, and voice applications.

The course was approximately 20 hours, and learners were expected to complete it over a period of four to five weeks. Participants received an INSEAD certificate upon successful course completion.

The WAP/ Web equation

This course used two delivery formats: Web and WAP. The WAP format requires short text, additional screens, and more titles than the Web version, resulting in a multilevel hierarchical menu system. An MS Word document that cross-referenced WAP chunks and Web topics was provided as a navigational aid.

Although 10 percent of the course was WAP-only accessible, 80 percent of the overall course was accessible via phone, including links to WAP sites, multiple-choice questionnaires, and quick reminders and alerts from the coaches. Likewise, approximately 20 percent of the course was Web-only, but nearly 90 percent of the overall course content was on the Web, including digital video clips, bulletin board discussions, email, and links to Websites. Obviously there was some redundancy.

Most learners accessed about 40 percent to 50 percent of WAP-delivered material and 70 percent to 80 percent of Web-delivered material. Reasons for accessing the course via the Web rather than WAP included small screen size, slow connections, and limited graphics.

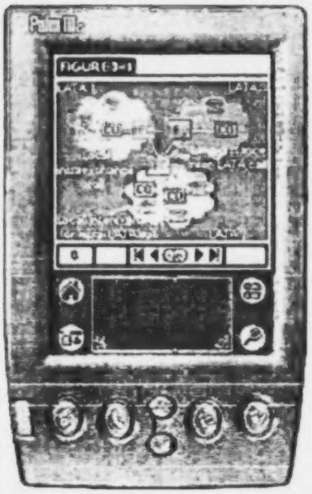
Prior to taking the course, most learners believed they would make little use of the phone. In fact, only five of the 14 participants said they expected to like using WAP-enabled phones for learning. Their opinion was based primarily on the notion that the phone's screen size was too small to be useful.

Following the course, participants reported that WAP-delivered content added value to the learning experience, saying that anywhere, any time access provided a high level of convenience.

M-learning's potential

Today, wireless development focuses on integrating data and voice functionality in a single device. Whether a mobile phone with Internet access or a handheld data device with phone capability, the goal is forindividuals to have wireless access to data applications. Handheld digital devices are becoming more common, and their quality and capability is increasing due to technological breakthroughs in miniaturization and advancements in wireless bandwidth and data networks.

Devices used in the project were the Palm Pilot IIIc and the Nokia 6210 WAP Phone:



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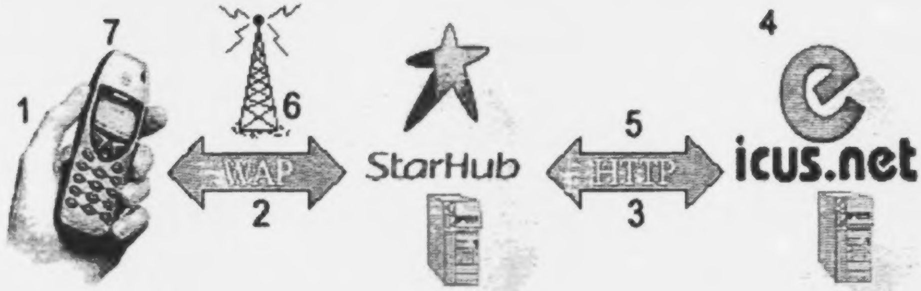
Conclusion

M-learning has been slow to grow because most wireless devices have small screens, low resolution, slow processing, and limited storage capabilities. Likewise, difficulty connecting various types of devices to the same network is a real limitation. It seems likely that m-learning is better suited to such specific content areas as sales or language skills. Also, current WAP technology makes it best suited to particular aspects of e-learning courses, such as

- quick reminders and alerts
- communication with peers and managers
- multiple-choice quizzes with immediate feedback
- daily tips
- glossary information
- browsing e-learning course material
- searching for specific information within a topic
- links to WAP sites
- course registration.

The course system for the project was illustrated thus:



12. University of Birmingham HandLeR project

www.eee.bham.ac.uk/handler/default.asp

The Educational Technology Research Group at the University of Birmingham runs the HandLeR programme whose aim is to develop mobile technologies for learning.

The concept HandLeR developed by the student group employs an animate mentor as the main interface metaphor and method of interaction. Figure 5 shows two screen displays from the implemented system. The mentor, shown as a cartoon rabbit, acts as an alter ego that could offer assistance with capturing events, solving problems and managing learning (these functions were not implemented in the demonstrator). The mentor also provides icons for the main tools of HandLeR, based on the mentor's body functions and displayed objects. Thus, clicking the mentor's eyes shows an image from the HandLeR's video camera, the palette brings up a set of drawing tools, the book opens the user's topic book, and the heart opens a profile of the user.

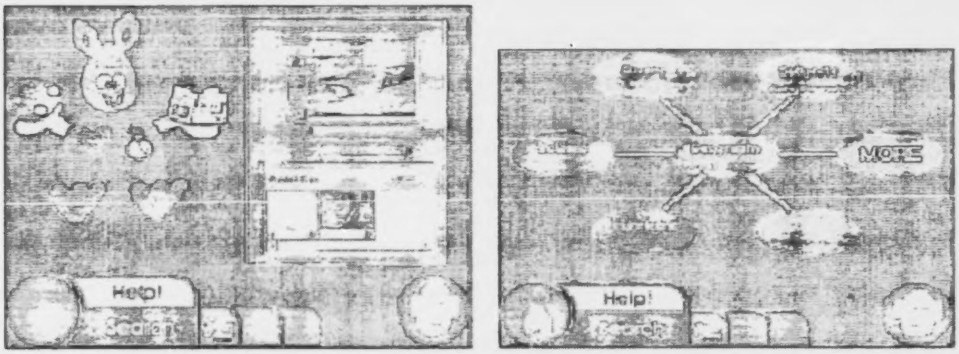


Figure 5. Two screen displays of a HandLeR for children aged 9-11 (from the undergraduate group design project).

Basic functions provided by the system include still and video image capture, drawing, and text input through a screen keyboard or handwriting recognition. Data from each of these sources can be tagged by time and location (demonstrated using a GPS position location card). The user can copy and organise the images, drawings and text in the topic book.

Clicking on the mentor's "brain" opens up a map (shown at the right of Figure 5)
showing linked concept words, named topics created by the user (from the topic book),and items of external information including web pages and documents. If the topic item is not available on the HandLeR then it automatically initiates a cellular phone connection to a web server and downloads the web page identified for that topic. For example, clicking on the "hurricane" topic item opens the web page http:\\www.hurricanehunters.com. The aim for future versions of HandLeR is to enable the user to create new nodes in the topic map for drawings, notes or camera images, linked together by title, keywords and time and place of origin.

The user can navigate through the topic map either by clicking on one of the outer ovals, which brings it to the centre and displays the topics related to it, or by clicking "search" and writing a keyword or phrase that identifies the topic. Much further work is needed to enhance the navigation and search facilities and to provide other views such as a timeline that orders events by time of creation.

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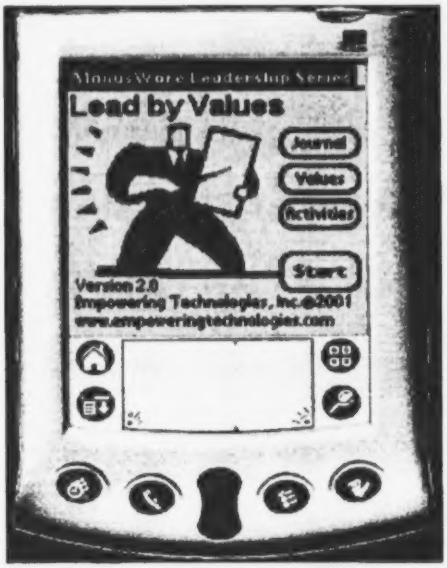
The main interface to the demonstrator system also provides a means to connect to other HandLeRs. Clicking on the face at the lower right of the screen opens a list of known contacts and selecting one brings up an image of that other person's mentor. The user can then click on the other mentor's body parts, such as the heart (to show the person's sharable profile). A click on the mouth or ears initiates a direct cellular phone connection that person's HandLeR.

The concept HandLeR runs on a Fujitsu Stylistic tablet computer with a Nokia GSM card phone. All the functions described above have been demonstrated on a handheld device consisting of a Fujitsu Stylistic pen-based tablet computer running Windows 95, a Nokia GSM card phone, a PCMCIA card GPS receiver, and a Kodak DVC 323 miniature digital video camera

13. Empowering Technologies, *The mobile learning era*
www.empoweringtechnologies.com

Empowering Technologies begin their presentation of their products with a list of statistics:
The evidence is overwhelming that mobile learning is beginning to take hold:

- Over 50 percent of all employees spend up to half of their time outside the office.
- More than 75 percent of all Internet viewing will be carried out on wireless platforms by 2002.
- Mobile devices will outnumber landline PCs by 2002 and exceed the 1 billion mark the following year.
- More than 525 million web-enabled phones will be shipped by 2003.
- Worldwide mobile commerce market will reach $200 billion by 2004.
- There will be more than 1 billion wireless internet subscribers worldwide by 2005.


MinusWare Leadership Series
Lead by Values
Journal
Values
Activities
Start
Version 2.0
Empowering Technologies, Inc.©2001
www.empoweringtechnologies.com

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The company plans to develop courses for the Palm V and offers this example:

14. Palmpowerenterprise (Knowledgenet and Smartforce)
www.palmpowerenterprise.com

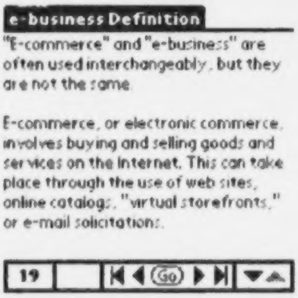
This is an analysis by J S Kossen of learning tools that run on Palm devices.

It claims that few companies are very far along in actually making mLearning a reality. It suggests that two exceptions are KnowledgeNet and SmartForce.

It is claimed that KnowledgeNet are able rapidly to develop content for PDAs that is as rich and interactive as it is for the PC. The courseware for the PDA contains animation, high-quality sound and intuitive navigation.

SmartForce see the greatest value of PDAs in assessment They are developing downloadable assessment exams that allow learners to test their knowledge and then rank and report their results. An example is given:

Let's take a look at an example. First, you need to go over the instructional material, like that shown in Figure A.



e-business Definition

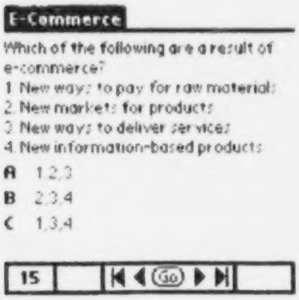
"E-commerce" and "e-business" are often used interchangeably, but they are not the same

E-commerce, or electronic commerce, involves buying and selling goods and services on the Internet. This can take place through the use of web sites, online catalogs, "virtual storefronts," or e-mail solicitations.

FIGURE A

First, you go over the lesson.

Then you're be given a series of questions to test your retention of what you read. A sample question is shown in Figure B.



E-Commerce

Which of the following are a result of e-commerce?

1 New ways to pay for raw materials
2. New markets for products
3. New ways to deliver services
4. New information-based products

A 1,2,3
B 2,3,4
C 1,3,4

FIGURE B

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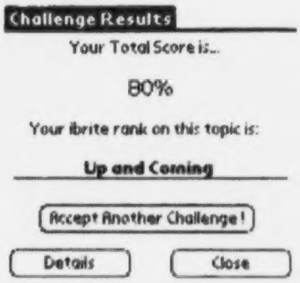
Test yourself with a series of questions.

Finally, you receive your score, as shown in Figure C.



Challenge Results

Your Total Score is...

80%

Your ibrite rank on this topic is:

Up and Coming

FIGURE C

The software tracks and reports your results.

15. Global Learning Systems www.globallearningsystems.com

Global Learning Systems is a major eLearning provider. Its website at http://www.globallearningsystems.com/ has a simulation of a course on PDAs with text audio and graphics.

Their system is called 'Learning to Go'.

Learning to Go™ Mobile Learning, Wherever You Are, Right in the Palm of Your Hand.

The PDA that manages your work life so effectively is now a delivery system for training, knowledge management and just-in-time performance support. Imagine downloading exactly what you need, when you need it - with full-motion video, audio and maximum interactivity. The performance improvement potential is unlimited when you deliver custom learning on a PDA.

The greatest benefit of this delivery method for training is the combination of true interactivity coupled with portability. Learners are no longer tethered to a classroom or even their desktop PC. Just as the cellular phone has become the preferred (mobile) person-to-person communication device, the PDA is rapidly becoming the preferred personal information organizer and information delivery device. Now, that "information" can be "training." The PDA gives learners the ability to learn wherever they are. That is a type of freedom we've not experienced before.

Learning to Go™, by the very nature of its instructional design infrastructure, leads organizations into true knowledge management. Using a series of unique 5-minute mentor lesson templates, virtually any type of training is modularized, stored in a database and reassembled on demand.

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16. Stanford Learning Lab

http://sll.stanford.edu/projects/tomprof/newtomprof/postings/289.html

Stanford University has a long history of leadership in distance learning in the US.

This is a highly innovative project to use mobile phones in language teaching at the university. It is grounded in the American tradition of using live lectures and teaching by satellite and videoconferencing as a characteristic of distance learning, rather than the individualized print based approach better known in Europe.

Cell phones, Palm Pilots, wireless Web - they help us check email, trade stocks and stay in touch - but can they help us learn? Can we, should we, try to fill in gaps of daily time with learning opportunities?

Last summer, the Stanford Learning Lab (SLL) developed a few rough prototypes for mobile learning. The SLL staff chose foreign language study as the content area, hypothesizing that mobile devices could help provide sorely needed opportunities for review, listening and speaking practice in a safe, authentic, personalized and on-demand environment.

The prototypes developed let users practice new words, take a quiz, access word and phrase translations, work with a live coach, and save vocabulary to a notebook - all in an integrated voice/data environment. The intent this summer was not yet to support an actual Stanford course, but instead to begin exploring recent technologies and fundamental human cognitive challenges involved in learning on-the-go.

Being mobile correlates with highly fragmented attention, and the challenge was to better understand what kind of learning can happen in those fragmented pieces of time.

Three User Modes and Technology Tests

SLL staff conducted three discrete technology explorations and informal tests on several language learners of varying skill, with the following general results:

Text Quiz: vocabulary quizzes over mobile phone-based wireless Web.

Pros - convenient small question chunks to test knowledge during opportunistic bits of time.
Cons - small screen is difficult to focus on while outdoors; small bits of text do not provide an immersive enough experience for learning new content.

Live Coach: live-voice coaching sessions over mobile telephones.

Pros - speaking with an expert is ideal for language practice.

Cons - comprehension can be difficult over the phone; time with real-live coaches is difficult to scale.

Interactive Audio: automated voice-controlled vocabulary and quiz sessions over mobile telephones

Pros - audio experience can coincide with other activities (driving, walking, waiting, etc.) instead of replacing those activities; automated system offers potential for scalable, personalized, database driven listening and speaking practice.

Cons - voice recognition technology, flaky and expensive mobile phone connections, and audio interface design complexities are just some of the potentially show-stopping technology challenges.

Automated Audio: General Responses and Guidelines for Design

While intitial test results were mixed, SLL continues to be intrigued by the potential for interactive audio to provide a scalable, rich, and flexible language learning environment. A summary of their user test findings and suggestions for future development follows.

Mobile Learning is a Highly Fragmented Experience:

Learning can be hard work. It requires concentration and reflection. However, being on-the-go (driving, riding a train, sitting in a cafe, walking down the street) is fraught with distractions. Users are in situations that place intermittent, unpredictable, yet critically important demands on their attention. Where does this leave the mobile learner? With a highly distracted, highly fragmented experience. The learning application must be designed with this in mind.

Learning is a Personal and Emotional Process:

Feeling shy about speaking your new foreign language, even with your teacher? Afraid you'll accidentally insult someone, or that they'll laugh at you? Learning is a sensitive process and language learning especially requires opportunities to practice in an emotionally safe and supportive environment.

The SLL's current interface is friendly, congratulates you when you get something right, and encourages you to try again when you don't.

User Frustration Wrecks Trust and Decreases Learning:

Poor cellular connections and environmental noises can cause imperfect voice recognition and therefore failed menu navigation and incorrect responses to learning interactions (such as quizzes). User observations indicate that repeated voice recognition misunderstandings impact users in interesting ways: on the surface, frustration and a reluctance to continue the lesson; on a perhaps less conscious level, a perception of the system as stupid or uncaring and therefore not an effective, trustful way to learn.

Also, not all misunderstandings are created equal. Users were more forgiving when the system made an incorrect response to their attempted Spanish than when it made an incorrect response to a simple navigation command like "back".

Did It Work?

This first attempt at supporting language learning over mobile phones was not perfect. While voice interface design and creating studio quality audio are not easy, these can be remedied with a more professional development process and budget than SLL had available last summer. What about the more fundamental question of learning over the phone and in a mobile environment? Is the technology far enough along? Can a threshold of usability be reached, even though it's not perfect? Yes, and no.

With care and attention some parts of the learning process can be supported. SLL's testing showed that simply having access to the application anytime, anywhere increased daily attention to learning Spanish and boosted motivation. However, highly fragmented attention and bleeding edge technology can result in an environment too frustrating for learning. The Learning Lab's advice is to keep it simple. Focus on those parts of the learning process most suited to audio, most suited to small chunks of time, and most suited to a highly distractable learner. Allow learners to personalize their experience - from personality to interaction mode - to match their own learning styles and situational needs.

17. Global Knowledge.com

www.globalknowledge.com

Global Knowledge have developed four of their courses for Palm computers:

- Understanding Network Fundamentals (483 text pages, 120 figures, 2450k file size)
- Telecommunications Fundamentals 1 (417 text pages, 48 figures, 1240k file size)
- Telecommunications fundamentals II (524 text pages, 65 figures, 1555 file size)
- Syngress CCNA Study Guide (1648 text pages, 120 figures, 4421k file size).

This is how they describe their system:

We have selected some of our most popular courses and made them available for use on your handheld PDA. Mobile Learning is the perfect pre and post course enhancement. With Mobile Learning, opportunities to reinforce your technical competence are greatly expanded - while traveling, in-between meetings, while waiting in line, or anytime you have a few minutes.

The Mobile Learning interface simplifies content navigation using familiar controls and speeds learning through four learning modes. These features are built around adaptive learning technology that remembers what material has been covered and focuses students on areas that require improvement.

Four Learning Modes Speed Learning and Reference

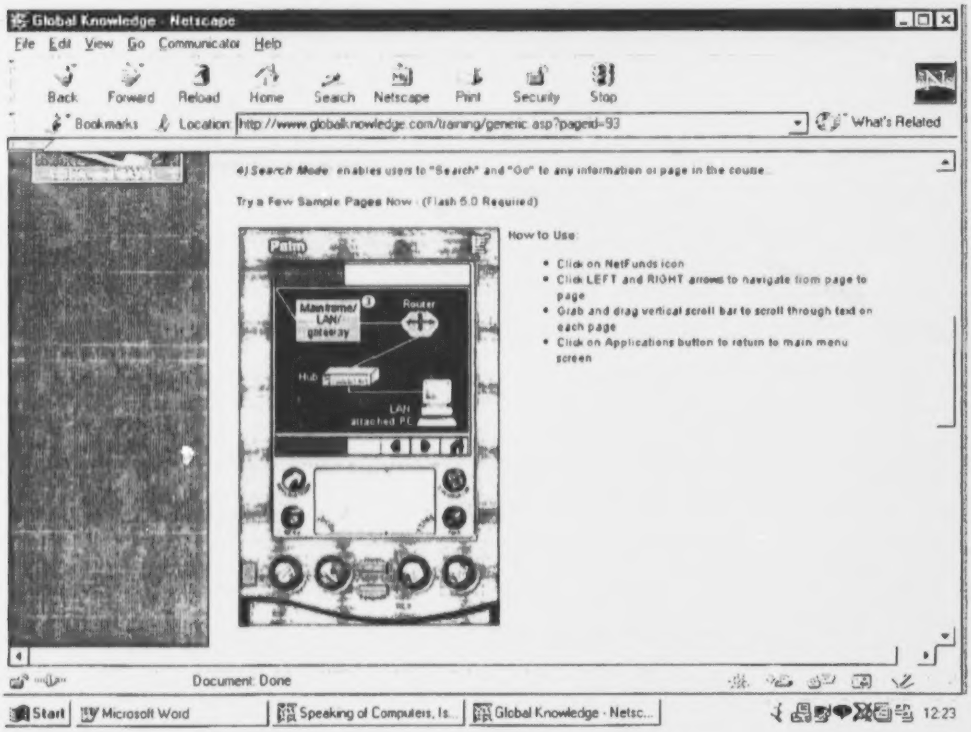
1) Fact Mode: allows the reader to efficiently access material sized and designed for the smaller handheld screen interface.

2) Q&A Mode: is a multiple-choice format, provided at the end of each section, with correct answers and optional supplementary information provided immediately after each question.

3) Challenge Mode: is similar to Q&A mode but results are summarized by category after all questions have been answered.

4) Search Mode: enables users to "Search" and "Go" to any information or page in the course.

This is the demo model of their system they provide:


Global Knowledge - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Stop
Bookmarks Location: http://www.globalknowledge.com/training/generic.asp?pageid=93
What's Related
Palm
Mainframe/ LAN/ gateway
Router
Hub
LAN attached PC
Document: Done
Start Microsoft Word Speaking of Computers, Is... Global Knowledge - Netsc...
12:23

4) Search Mode: enables users to "Search" and "Go" to any information or page in the course.

Try a Few Sample Pages Now : (Flash 5.0 Required)

How to Use:

- Click on NetFunds icon
- Click LEFT and RIGHT arrows to navigate from page to page
- Grab and drag vertical scroll bar to scroll through text on each page
- Click on Applications button to return to main menu screen

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Demonstration model of Globalknowledge.com system.

18. HICE University of Michigan

www.handheld.hice.

HICE is the Centre for Highly Interactive Computing in Education at the University of Michigan. They have made highly successful applications for education on palmtops especially for children in kindergarten and primary school. They write:
Computers can be great learning tools when used effectively, but high costs have long hindered educators from providing each student with a laptop or desktop unit of their own. Today, handheld devices such as Palms are making technology accessible, affordable, and fun for teachers and students alike. The folks from Hi-CE (Center for Highly Interactive Computing in Education at the University of Michigan) have developed a collection of Palm applications for the classroom along with instructions for each. We gratefully acknowledge the support provided by these organizations: National Science Foundation, Intel, Handspring, Inc, Microsoft, Palm, Inc., Sun Microsystems

19. Northern Alberta Institute of Technology

www.nait.ab.ca/MobileLearning/defaultSP.asp

This is a Canadian project, led by the Northern Alberta Institute of Technology, which seeks to put learning materials for college students on palmtops.

Accounting students can now lead the way in the cool factor. What' s new in accounting? While general ledgers and T-accounts are at the heart of any accounting course, what's new with first year Accounting students is mobile accounting. On the go, anytime, anywhere access to accounting materials and access to other learners through NAIT's student chatter mobile messaging tool.

Students involved in this pilot project will have the use of a PDA (Personal Digital Assistant) to keep in touch and on task, enabling them to keep up with assignments, and happenings when around campus and around world.

While accounting students are integrating the use of PDAs in their studies, NAIT will be measuring the success of the project with compressive applied research. This research will measure the effectiveness and efficiency of using mobile computing to achieve learning outcomes, enhance student success and provide access to student services on and beyond campus. The research design involves accounting students in PDA-enabled classrooms, laptop classrooms and traditional classroom settings at NAIT and at Seneca College in Toronto.

Project Goals:

The pilot project's overall goal is to assess handheld wireless technology in a first-year post-secondary accounting course as a value-added tool that: enhances student success, increases student access to the Institutes' services and expands the body of teaching and learning strategies available to faculty.

Here is an evaluation of the project from Seneca College in Ontario:

Over the last year, several leading educational institutions, and technology and educational companies have joined forces to create a unique learning experience for you. The goal of the Mobile Learning Project is to enhance your study of accounting using a wireless iPAQ and content specifically designed for it. With this device you won't be tied to the school, home, or even a library to study online. You'll be able to study when and where you want, on or off-campus! Imagine emailing your friends about the latest assignment while riding the local transit? How about searching the library stacks while waiting in a lineup? You could also study that newest content that your teacher recommended while having a coffee with your friends.

The content that has been specially designed for this project is compatible with your textbook, *Fundamental Accounting Principles*. Some great new features have also been created for you that your book doesn't have:

- Interactive problems, including journal entries, trial balances and quizzes that give you immediate results.
- Chapter summaries that you can highlight, underscore and bookmark.
- Conceptual animations & interactivities that illustrate key concepts introduced in the book.
- Audio and video files that are great supplements to a lecture.

An innovative group of educational institutions, and technology and educational companies has made this experience possible for you. The Mobile Learning Consortium is comprised of post-secondary institutions-Seneca College <http://www.senecac.on.ca/> and the Northern Alberta Institute of Technology <http://www.nait.ab.ca/>-and leading educational publishing and technology companies.

Project Partners

A consortium comprising public and private industry partners is exploring the possibilities of wireless technology and its application to teaching and learning. These partners include:

Northern Alberta Institute of Technology (NAIT)
Seneca College
McGraw-Hill
Bell Mobility
Blackboard
Cap Gemini Ernst & Young Canada
Compaq

20. goReader

GoReader is a Tablet PC, which is being used to provide k-12 (kindergarten to matriculation) education with web browsing, basic computing and ebook functionality. It is also claimed that its mobile learning solutions provides students, institutions and professors with access to all of their information. It has the following functionality:

- Connect to the Internet wirelessly, via a LAN or Dial-in connection.
- Enjoy full-page 800x600 Web browsing.
- Access your corporate network utilizing Citrix ICA or Microsoft's RDP.
- Synchronize with Microsoft Outlook to download important emails and contact information.
- Download, revise and upload Office, PDF, HTML and many other documents with goReader's multiple format support.
- Draft Word, Excel and email documents easily via a virtual keyboard, USB keyboard or handwriting recognition.
- Jot notes on screen in your own handwriting with Ink Memo.
- goReader weighs only 2.4 pounds, yet is secured by a durable magnesium housing.
- Windows CE operating system provides users an intuitive, familiar interface.
- Supports all Windows CE applications.
- Memory is easily expandable using CompactFlash or PC Card options.
- SuperVGA 10.4" TFT touchscreen provides a bright, easy read.

21. Latitude 360

Experient Technologies, LLC the leading developer of mLearning(tm) systems, has announced that Latitude360, a division of RWD Technologies(tm) and the market leader in delivering integrated Internet-enabled business and learning solutions, has licensed Experient's Calypso technology to provide a mobile access option to its University360.

University360 is an end-to-end learning solution composed of best-of-class, off-the-shelf-products that have been fully integrated to provide a complete online learning environment. Through its Calypso licensing agreement with Experient, Latitude360 will launch a new primary component, MobiLearn360(tm) to University360 that will provide mobile clients with access to their courses that is not dependent on continuous online connectivity.

MobiLearn360 will enable learners to download applications from the University360 learning management system and then disconnect from the Web and use the training applications at any time in offline mode exactly as if they were online, with full browser functionality and offline student tracking.

For many learners, particularly mobile workers, this option offers the benefits of convenience and network cost effectiveness.

22. The mLearning Forum www.pjb.co.uk/mlearning

The m-Learning Forum is an initiative of Peter Bates, manager of P.J.B associates at Ely, Cambridgeshire, United Kingdom.

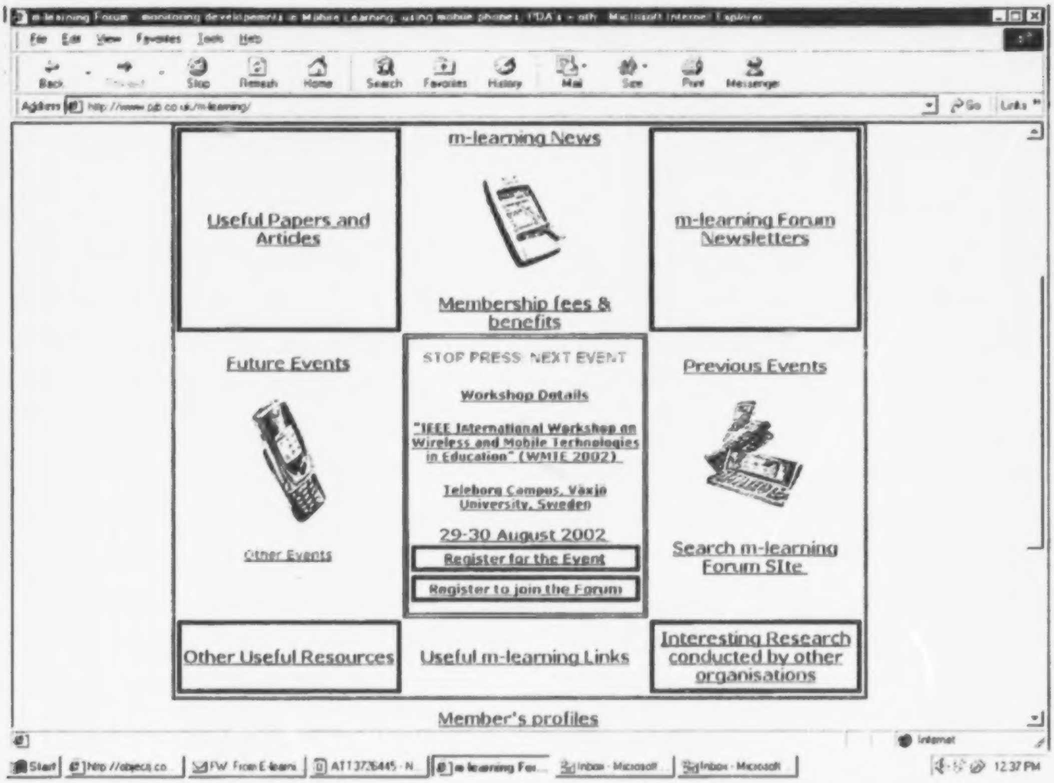
By clicking on m-learning on his website at http://www.pjb.co.uk one is taken to a listing of various activities related to m-Learning. There is a rationale for establishing a European m-Learning forum, details of a conference on the theme organised for 31 October to 1 November 2001 in Paris, presentations from the first meeting of the m-Learning forum on 24 September 2001, and a comprehensive listing of useful papers and articles.

Speakers at the first meeting of the forum included:

"Introduction - developing m-learning - the time is right?"– Peter Bates, pjb Associates
"Market Trends in Mobile and Wireless Developments – opportunities for m-learning" Phil Kendall, Director Strategy Analytics Global Wireless Practice
"Developing m-learning - Pedagogical and Design Perspectives" – Prof. Mike Sharples, Kodak/Royal Academy of Engineering Professor of Educational Technology, University of Birmingham (UK)
"Opportunities for European Research and Development in m-learning" – Joseph Bremer, European Commission. DG Information Society (Luxembourg)

As the following illustration shows the mLearning Forum offers the following facilities:

- mLearning news
- useful papers and articles
- mLearning Forum newsletters
- future mLearning events
- next mLearning event
- previous mLearning events
- other useful resources
- useful mLearning links
- interesting research conducted by other organisations.


m-learning Forum - monitoring developments in Mobile Learning, using mobile phones, PDA's + oth - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Size Print Messenger
Address http://www.pjb.co.uk/m-learning/
Go Links
m-learning News
Useful Papers and Articles
m-learning Forum Newsletters
Membership fees & benefits
Future Events
STOP PRESS: NEXT EVENT
Workshop Details
"IEEE International Workshop on Wireless and Mobile Technologies in Education" (WMTE 2002)
Teleborg Campus, Växjö University, Sweden
29-30 August 2002
Register for the Event
Register to join the Forum
Previous Events
Other Events
Search m-learning Forum SIte
Other Useful Resources
Useful m-learning Links
Interesting Research conducted by other organisations
Member's profiles
Internet
Start
12:37 PM

23. eClipse www.e-learningcentre.co.uk/eclipse

eClipse is a comprehensive eLearning site hosted by the elearning Centre in the United Kingdom. This site offers an extensive list of references to mobile learning

- resources
- content providers
- vendors

with evaluation notes on each entry.

24. mLearning Conference, Paris, 31 October – 1 November 2001

Pjb Ltd of Ely, Cambridgeshire, England organised an international conference on mLearning in Paris, France on 31 October 2001 to 1 November. The themes and conference addresses give a good idea of the state of mobile learning in late 2001.

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This is the conference presentation:

INTERACTIVE TV & MOBILE LEARNING

Putting the 'M' & 'T' Into eLearning -
New Business Opportunities?

EVOLUTION

Global innovators are constantly pushing the education revolution forward. The evolution of interactive television and new developments in mobile handsets are providing a whole new playing field for technology-based learning. Understanding and realising the vast potential of this expanding industry will be vital to its commercial success in the future.

A PAPERLESS UNIVERSE?

So throw out your textbooks. It is official - mobile and television learning resources are here - a brave new world is upon us. The future of education will undoubtedly be very much at the learner's convenience.

FIND THE ANSWER

This conference builds on the success of last year's Interactive TV & Online Learning event, which was held in London and attracted educational, online and interactive TV innovators from across Europe and the US.

KEY PRESENTATIONS HAVE BEEN CONFIRMED FROM THE FOLLOWING ORGANISATIONS:

- BBC
- BTopenworld
- Datacash
- Datamonitor
- Discovery Channel
- Electronic Publishing Services
- Enterasys Networks
- Granada
- ICL
- Icus.net
- Isopia
- London Borough of Newham
- Motorola
- needleworkTV
- NOP
- PacketVideo
- pjb Associates
- Pogo Technology
- Quiero TV
- Questions Internet and Information Services
- SmartForce
- The Fantastic Corporation
- University of Birmingham
- University of Helsinki

WHO WILL YOU NETWORK WITH?

- Broadcasters
- Cable and Telecom Network Service Providers
- Learning Content Providers
- Government Education Agencies
- Policy Makers of Universities, Schools and Colleges
- Human Resource and Training Directors
- Publishers
- Digital TV Platforms
- Education Brands
- Internet Consultancies

Here is the conference programme and list of speakers:

Day One
MOBILE LEARNING

9.15

Registration and Coffee

CHAIR:

Peter Bates, Senior Partner pjb Associates (UK)

9.30

CHAIR'S INTRODUCTION

TRENDS TOWARDS MOBILE LEARNING

KEYNOTE SPEAKER:

9.45

iTV and Mobile Learning: Multi-Platform Opportunities

Dave Cockram, Managing Analyst
Datamonitor (UK)

KEYNOTE SPEAKER:

10.15

mLearning in Motion

- Aditya Jha, VP of Marketing and Sales
- Payman Hodaie, CTO Isopia (Canada)

10.45

M-Kids: The Future is Mobile

Barbie Clarke, Director NOP Family
NOP World (UK)

11.15

Morning Coffee and Networking

11.30 **HandLeR: A Handheld Learning Resource**

Mike Sharples, Kodak/Royal Academy of Engineering Professor of Educational Technology
University of Birmingham (UK)

EXISTING AND EMERGING WIRELESS TECHNOLOGY SOLUTIONS

12.00

Using Wireless Multimedia to Power Mobile Learning

Patrick Parodi, General Manager for Southern Europe
PacketVideo (UK)

12.30

How Will Future Technologies Affect the Way we Learn on the Move?

PANEL:

- Patrick Parodi, General Manager for Southern Europe, PacketVideo (UK)
- Reidar Wasenius, Content Specialist, Nokia Ventures Organisation (Finland)
- Rob Edmonds, Senior Industry Analyst, SRI Consulting Business Intelligence (UK)
- Stacy Hanley, Director of Business Development, Motorola University (USA)

13.00

Lunch

LEARNING FROM EARLY ADOPTERS

14.15

Working with Nokia and INSEAD to deliver an eLearning Course Using Both Web and WAP Technologies

Geoff Ring, Academic Director Icus.net (Singapore)

14.45 **Integrating Technology into the Classroom to Enhance the Teaching Environment**

Neil Wilkins, Director of Solutions Marketing EMEA Enterasys Networks (UK)

15.15

Wireless eLearning: Turning Pointless Delays into a Learning Experience

Laura Overton, Global Programmes Manager, SmartForce (UK)

15.45
Afternoon Tea
16.15
Sparking the Mobile Education Revolution: Instant, Affordable Access to Information that is Relevant, Accurate and Up-to-Date
Eoin McGloughlin, Director of Content and Services
Pogo Technology (UK)
16.45 **mLearning - The University in your Pocket! - The UniWAP Project**
Janne Sariola, Project Manager, Educational Technology Centre for ICT
University of Helsinki (Finland)

PAYING FOR LEARNING CONTENT

17.15
Adding Payments Functionality - Turning e-Business into e-Commerce
Gavin Breeze, Founder , Datacash (a subsidiary of auxinet plc)
17.45
Chair's Closing Remarks

25. Conference in Finland 26 April 2002

This conference with the theme 'Finland as a laboratory of mobile technologies' gives an indication of the activities and innovators in mobile learning in early 2002.

Jari Multisilta (Tampere University of Technology) *mLearning - visions for the future*

Jussi Luukkonen (TietoEnator) *Digital media in mobile devices*

Matti Sinko (Helsinki University of Technology) *Finnish virtual university - towards mLearning*

Riitta Vänskä (Nokia e-learning) *Mobile phones as end-terminals for m-learning*

Peter Bates (pjb Associates) *Developing the m-learning Forum*

Harri Alamäki (Radiolinja Oy) *Learning and Mobility*

26. European workshop on mobile and contextual learning, University of Birmingham, UK June 20th and 21st 2002

This is an important conference in mid-2002 organised under the leadership of Professor Mike Sharples of the Educational Technology Researcg Group of the University of Birmingham, U.K.

WORKSHOP PROGRAMME

Dr. Michael Gardner, Deputy Director, Institute for Socio-Technical Innovation & Research, The University of Essex, @BT Adastral Park
Many devices - Many networks: New services, technologies and challenges

M. Farmer, B. Taylor, Birmingham Grid for Learning,
A Creative Learning Environment (CLE) for Anywhere Anytime Learning

C. O'Malley, D. Stanton, University of Nottingham,
Tangible Technologies for Collaborative Storytelling

R. Luckin, D. Connolly, L. Plowman, S.Airey, University of Sussex,
The Young Ones: The Implications of Media Convergence for Mobile Learning with Infants

A. Stone, J. Briggs, Kingston University,
ITZ GD 2 TXT

I. Garner, J. Francis, K. Wales, Sheffield Hallam University,
An Evaluation of the Implementation of a Short Messaging System (SMS) to Support Undergraduate Students (S)

T. Rogers, University of Exeter,
Mobile Technologies for Informal Learning – a Theoretical Review of the Literature

J. Taylor, L. Peake, D. Philip, S. Robertshaw, Liverpool John Moores University,
Location Activated Nomadic Discovery (LAND): A Mobile Location-Sensitive Visitor Information and Navigation Service for Cumbria

G. Vavoula, M. Sharples, University of Birmingham,
Requirements for the Design of Lifelong Learning Organisers
T. Koppi, University of New South Wales,
Authentic Contextual Lifelong Learning Design

J. Wood, G. Price, D. Laird, S.Robertshaw, Liverpool John Moores University,
Mobile Devices for Breast Care: A Personalised Education Information Profiling System (PEIPS)

A. Kukulska-Hulme, The Open University,
Cognitive, Ergonomic and Affective Aspects of PDA Use for Learning (S)

J. Waycott, E. Scanlon, A. Jones, The Open University,
Evaluating the Use of PDAs as Learning and Workplace Tools: An Activity Theory Perspective

M. Anteboth, M. Tangermann, G. Weber, Harz University of Applied Studies,
Organizing Mobile Teaching

M. Collett, G. Stead, CTAD Ltd.,
Meeting the Challenge: Producing M-Learning Materials for Young Adults with Numeracy and Literacy Needs

27. IEEE international workshop on mobile and wireless technologies in education. 29-30 August 2002, Växjö University, Växjö, Sweden (WMTE 2002)

Another important conference with an international listing of speakers. Again the presentations reflect the state-of-the-art and current activities and preoccupations in the field. The list of speakers give contacts and an indication of where the innovations are taking place. Many of the presentations are hyperlinked in full at the websites

xTask – adaptable working environment Ketamo (Finland)

A Mobile Scaffolding-Aid-Based Bird-Watching Learning System Chen (Taiwan)

Applying Wireless Technologies to Build a Highly Interactive Learning Environment Liu (Taiwan)

Design and Implementation of Ad Hoc Classroom and eSchoolbag Systems for Ubiquitous Learning Chang (Taiwan)

Walking & Talking -Sharing best practice Lundin (Sweden)

Handheld Use in K-12: A Descriptive Account Curtis (USA)

Research to Industry. Four Years of Observations in Classrooms Using a Network of Handheld Devices Davis (USA)

Collaboration Design Patterns: Conceptual Tools for Planning for The Wireless Classroom DiGiano (USA)

The Electronic Guidebook: A Study of User Experiences using Mobile Web Content in a Museum Setting Hsi (USA)

28. J. Sariola, *What are the limits of academic teaching? - In search of the opportunities of mobile learning*

Sariola from the University of Helsinki attempts to propose analytical and theoretical structures for mobile learning in a Finnish setting. He describes two mobile learning projects carried out in Finland and attempts to gauge the importance of mobile learning for university lecturers in Finland. He writes:

Mobile learning: added value to academic teaching

The development of mobile learning has encountered several obstacles, which explains why the use of mobile technology has not yet spread to a wider audience. The high line costs of GSM and WAP phones have proved particularly problematic. Although students are avid users of the mobile phone in their personal lives, it has yet to make a breakthrough in education. The screen of the phones is small, which makes it fairly difficult to read the text and to write long messages. But despite these problems, the contribution of mobile technology to academic teaching is already becoming apparent. These are some of the advantages it will provide:

1. *Experiential and authentic learning situations*

Mobile devices enable students to interact with researchers in real-life learning situations outside the university. It is particularly important to engage researchers in answering students' questions while working in authentic research situations. Examples of such situations include an archaeologist working on an excavation site or a biologist carrying out research at the seaside. A real-time connection to authentic situations seems to support experiential learning. Moreover, students become better able to compare various authentic environments, for example regional geography and map instruction in a forest.

2. *Enhanced availability of guidance and support in learning situations*

Students get support from their supervisor or teacher if necessary. A mobile device establishes an uninterrupted and flexible connection between student and teacher. From the teachers' point of view, it is important to be able to provide guidance and support to students when necessary.

3. *Fast production of digital learning materials and copyright issues*

At present, universities may produce their own photographic and text material by having their personnel take photographs in authentic situations (for example, of a plant at the seaside) and send the digital images to the university's image database. The copyrights of such image material have proved problematic. An image database allows the university to create its own image bank, from which it may exchange or sell images to other universities. However, the central aspect of this materials production is its quick distribution to students, which allows for up-to-date research information to be used in teaching.

Mobile technology is a new approach that expedites the production of new information and reinforces the basic task of universities, which is to engage in state-of-the-art research and teaching. Mobile technology also enhances the quality of learning by introducing experiential aspects, since it enables increasing interaction between universities and the society as a whole. The Internet and mobile solutions create a new, flexible and wireless campus for students.

4. *Increase in external expertise in teaching and research*

When necessary, mobile technology connects students with experts. More than ever before, students can experience the authentic working situations of researchers.

5. *Expansion of open and flexible learning*

Mobile learning may be considered as an extreme form of flexible learning. Students may establish a connection to an information network at their own convenience. It is particularly important to allow students to define their own learning and guidance needs, and use mobile technology to support learning when it suits them.

Mobile technology is only beginning to take its first steps in academic teaching. The opportunities it creates have, however, already been recognised and the idea of a wireless campus is spreading to universities. The integration of the Internet and mobile solutions will transform the use of ICT in teaching and take it in the direction of open teaching, provided that mobile technology is seen as a strategic choice for the development of academic teaching. It is of central importance to define the methods and models of flexible learning. Mobile technology must be seen as a part of the learning process. The phases when information is procured and innovations are developed are especially important, for it is then that the student breaks away from the physical space of the university and enters the environment of authentic information. New mobile technology acts like a vacuum that gathers ideas from its environment. Having procured the necessary information, the learner returns to the computer to process this information further. To conclude, it is still important to examine the concept of high-quality learning and the added value that mobile technology creates. The core characteristic of mobile learning is that it enables learners to be in the right place at the right time, that is, to be where they are able to experience the authentic joy of learning.

29. K. Nyiri, *Towards a philosophy of m-learning*

Nyiri, from Hungary argues that there are two scenarios for mobile learning: either e-learning will automatically become m-learning when wireless devices replace wired ones or that m-learning characteristically aims at knowledge that is location dependent. He proposes a third scenario and writes:

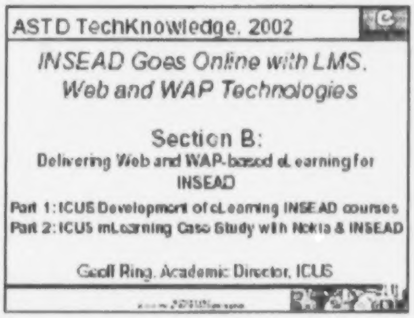
There are two familiar approaches to the issue of mobile learning. The first points out that since the dominant mode of access to the Internet will soon be through wireless devices, e-learning simply becomes m-learning, without any particular changes in content.

The second approach stresses that m-learning will characteristically aim at specific kinds of knowledge, namely knowledge that is location-dependent and situation-dependent.

The present paper offers a different line of argument. On the Internet e-mail is the most popular application, and mobile devices, too, are used mainly for purposes of person-to-person communication. These
observations confirm the view, long entertained in philosophy, that to communicate is an anthropological necessity.

Starting from an analysis of the ubiquitous nature of communication the paper refers to the intimate connection between communication and education, and proceeds to examine the historical origins of the separation between school and society; recalls that childhood itself is socially constructed; and points to the advantages of a learning environment containing not just texts but also pictures. In such an environment person-to-person mobile communication by itself becomes learning. Communication is the source from which m-learning emerges.

30. G. Ring, *mLearning case study with Nokia and INSEAD*



ASTD TechKnowledge, 2002

INSEAD Goes Online with LMS, Web and WAP Technologies

Section B:

Delivering Web and WAP-based eLearning for INSEAD

Part 1: ICUS Development of eLearning INSEAD courses

Part 2: ICUS mLearning Case Study with Nokia & INSEAD

Geoff Ring, Academic Director, ICUS

This is not a merely theoretical study but reflections on a practical application of mobile learning carried out by ICUS, INSEAD and Nokia.

Ring discusses the future devices for mobile learning. He states that PDAs are not mass market products (only 2m worldwide) and that mobile phone users will grow to 1b by end of 2002 with ownership of mobile phones >50% in some countries; he seems to favour a hybrid PDA phone. His course was 70% on WWW and Wap, 20% WWW only and 10% Wap only.

He queried his participants on the value of the Wap component:

- Impressed with Wap component; surprised how useful it was
- The Multiple Choice Questions with immediate feedback were excellent
- It was good to be able to access the course while travelling in a taxi or waiting for a bus.
- The SMS reminders from the coach were useful, especially for overdue assignments.

When asked about stand-alone Wap courses the responses were more negative:

- No. The screen size was too small
- Too much reading from a small screen
- Less graphics and interactivity.

Ring lists the advantages of mobile learning as: sheer convenience; people are used to having mobiles with them at all times; mobile devices are cheaper, easier to use and maintain; continuous connection gives accurate, up-to-date data; mobiles are better communication devices than PCs for learners and coaches.

He lists his key success factors for mobile learning as:

- Make optimal use of portability; location; wearability; networked communication; personalization; blended learning opportunities
- Increase speed, bandwidth, ease of use, durability and input/output quality
- Decrease size, weight, power demands, maintenance and price
- Design educationally sound learning that is interactive, authentic, collaborative, user-centered and media rich
- Seamlessly integrate device and network technologies.

CHAPTER 5 mLEARNING ON THE SCREENPHONE

The concept

The original concept of mobile learning contained the trialling of mLearning on screenphones, like the Ericsson HS 210. In this way it was felt that all facets of mobile learning could be demonstrated: the screenphone, the Personal Digital Assistant (PDA) and the mobile phone.

It was suggested that the use of the HS 210 or a similar technology to achieve the following aims:

- The provision of course content to off-campus students
- The provision of feedback to off campus students
- The provision of student support services for off campus students
- Links to the WWW and other resources
- Student to student interactivity
- Student to tutor and institution interactivity.

Each of these dimensions would be analysed and evaluated on a four point grid for decision makers:

- Student userfriendliness
- Didactic effectiveness
- Technical feasibility
- Cost effectiveness.

Illustration

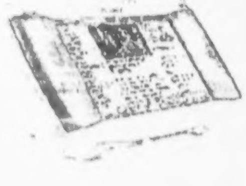
This is the HS 210 wireless screen phone first demonstrated in March 2000

Screen Phone brings Internet to the sofa

[First published 25 February 2000]

One piece of hot news at CeBIT was the new Ericsson Screen Phone, HS210, a cordless Bluetooth connected screen which offers Internet access, telephony and e-mail services.

"With this device users are freed from the tyranny of cables in the home," said President Kurt Hellström, when unveiling the new product to the media.
"Exhibition visitors are very positive to this product. Instead of being tied to the computor in the spare room, you can browse the Internet, make phone calls or send e-mails simultaneously from the comfort of the sofa," explains Björn Krylander, head of the Home Communications business unit.
The Screen Phone has a color touch screen, on which the Internet and other functions can be launched at the touch of a finger. The user can talk on the phone by using the speakerphone or the hands free.
The Screen Phone will hit the market towards the end of the year.



The sereenphone offers the following functionality:

- An A4 size screen that would make studying feasible; this is important given the frequently expressed opinion that the screen size of a mobile phone would make studying difficult
- Wireless connectivity
- Bluetooth enabled functionality
- Internet access
- Email access
- Colour screen
- Touch sensitive screen
- Speaker telephone
- Hands-free telephone.

Limitations

With a large screen for studying course content, email access, internet access and telephony, the screenphone has much of the functionality needed for successful mobile learning.

Its major limitation was lack of availability.

The study of mobile learning was designed from the literature evidence that distance learning systems follow the availability of technologies to citizens and that technologies, no matter how pedagogically suitable, were not successful if they were not generally available to students.

It was the penetration of the mobile telephone worldwide that was the nucleus of the concept with Nokia and Ericsson forecasting that by the end of 2002 there would be 1.000.000.000 of them for a world population of 6.000.000.000.

It was never likely that students would purchase a device like the screenphone merely for the purposes of study. If the screenphone was not generally available in homes for students to use. Its value for mobile learning was minimal.

It was never likely that these large A4-sized phones would penetrate the mass market. This was confirmed in early 2001 when Ericsson suspended production of the screenphone HS 210.

This decision to suspend production does not in any way weaken the field of mobile learning because it is most unlikely that the screen phone would ever have played an important role in mobile learning.

CHAPTER 6 mLEARNING ON PERSONAL DIGITAL ASSISTANTS (COMPAQ IPAQ)

Early studies produced the definition of mobile learning. It is couched in these terms:

During the course of the wireless learning to date it has become apparent that there are several interpretations of mobile learning. These include wireless LAN (WLAN) technologies and the combination of mobile phone and laptop computer supporting a learning event (an analyst suggested the phrase "battery learning" to describe these combinations). It is accepted that these scenarios may be defined by some as mLearning and it is accepted that there is an element of mobility in each. One can construct a grid contrasting mobility with functionality such that these scenarios score high on functionality but low on mobility. This study places its research at the opposite end of the grid whereby the emphasis is on mobility and the testing of functionality with devices clearly in the mobile technology arena. It was felt that this would lead to a truer exploration and evaluation of the issues, positive and negative, of a mobile learning experience.

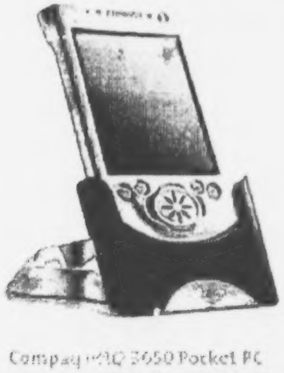
Thus the study's definition of mobile learning coincides with the review of the literature presented in Chapter 4 above as considering that the term mobile learning should include learning scenarios with mobile phones, palmtops, handhelds and PDAs, but regarding laptop computers as outside its focus.

Thus the development of learning scenarios and distance learning courses for PDAs, like the Compaq iPaq, is central to the concept and as most of the work described in Chapter 4 is on the development of scenarios for palmtops and PDAs it would be quite unrealistic not to have a central focus on development for PDAs.

Illustration

The Compaq iPAQ is a handheld computer giving full internet access and a wide range of functionality which mobile learning is harnessing for learning. It has a touch sensitive screen that can be activated with a stylus and has a fold-out keyboard that enables easy typing input.

Here is an illustration of a recent model:



Compaq iPAQ 3650 Pocket PC

Limitations

The screen size of the Compaq iPAQ or of any handheld palmtop or PDA is small and has inherent difficulties for the presentation of course content in a distance learning context. Most people using them, however, appear to be able to read data from them with a certain amount of ease.

The concept of mobile learning has a central relationship to mobile telephony and the absence of a telephone contact, and the necessity to use a mobile telephone, with them is an important consideration.

Decision

A central part of mobile learning as detailed in the literature search presented in Chapter 4 deals with handhelds, palm tops and PDAs. There is very little development at this stage for mobile or cell phones. The project decided therefore to put a major part of its development effort into explorations of didactic constructs and course provision on the Compaq iPAQ.

Development of system for Compaq iPAQ

Fagerberg, Rekkedal and Russell in their, *Designing and Trying Out a Learning Environment for Mobile Learners and Teachers* describe the development of the didactic environment system for the Compaq iPaq at NKI in Norway thus:

This paper summarises the work package carried out at NKI Distance Education during the year 2001 of the EU Leonardo Project, *"From e-Learning to m-Learning"*.

Development of the wireless Compaq iPaq

The concepts, distance education, e-learning and m-learning are discussed with reference to NKI Distance Education philosophies, views on learning and experiences in developing learning materials for distance education and online learning.

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During 2001 NKI project team studied International experiences concerning m-learning, analysed technological solutions and pedagogic/didactic needs based on our internal practical experiences and results from previous surveys and evaluation studies among our distance students.

The technical solution chosen was to try out the use of Pocket PC/Personal Digital Assistant (PDA) in combination with mobile phone for distribution of learning content and communication between tutor and students, between students and for students' communication with the learning material. As technologies develop so fast that the specific technology available changes from one week to the next, it was important that the solutions chosen had some generic basis, i.e. also that the specific brands of PCs, mobile phones and keyboards etc. should not constitute any substantial restrictions concerning generalisability of our experiences.

When we had to do make our choice late spring 2001, we found that after analysing functionality of different brands of PDA/Pocket PC, we chose to build our learning environment around the Compaq iPAQ 3630 and 3660. The mobile phones chosen were Ericsson T39 and Ericsson R580.

The next steps for NKI Distance Education in the project will be to carry out the first experiment of a partly real and partly simulated distance learning setting including evaluation, carry out a survey among distance learners on aspects of mobility and plan and conduct a second experiment in a fully realistic setting.

The actual course chosen, *'The tutor in distance education'* was chosen for the following reasons:

- It is a course in the pedagogy of distance teaching, and as such represents an ideal course for combining the research on media, methods and technology with the substance or content of the learning
- It is taught by internal NKI staff, also involved in the project, thus combining internal competence development with development work in the project
- The fact that same staff are involved in development and teaching in the practical try outs to be carried out opens for real field research during try out and also makes it easier to transfer the experiences and results from the experiments to further developments in the operations of the NKI Internet College
- Students taking the course are prospective online teachers in the NKI Distance Education system, their experiences as mobile learners are transferred to their teaching after completing the course

In this section of their report Fagerberg et al present their decisions to develop mLearning systems for the PDA, Compaq iPaq. In the following section they present theoretical analyses of learning usine the work of the German scholar, Dichanz.

Theoretical constructs on the nature of learning

'Distance education' and *'distance learning'* are well-established concepts (Keegan 1996). The *'distance learner'* is a person who, for some reason, will not or cannot take part in educational programmes that require presence at certain times or places.

Recently terms such as *'e-learning'* and *'m-learning'* have entered the scene. To us, learning is an activity or process and shown as a change in a person's perceptions, attitudes or cognitive or physical skills. It cannot be *'electronic'* (if that is what e-learning is supposed to stand for (?)). The terms e-learning and d-learning deserve to be analysed. For instance, the term, e-learning, seems to be used to convince users that some supernatural things happens with your brain when you place yourself in front of a computer screen. This miracle is very unlikely to happen, as learning in the real world is mainly hard work. Most examples of so-called e-learning programmes seem to be extremely costly to develop and most often covers low-level knowledge and facts based on a simplistic view of what learning is (see e.g. Dichanz 2001 *"E-learning, a linguistic, psychological and pedagogical analysis of a misleading term"*).

However, as the term seems to become part of accepted terminology, it is imperative for educational researchers and serious providers to define it and assign meaning that is in accordance with our views on teaching and learning. Seen from a university perspective, Dichanz, who is professor of education and the German FernUniversität ends his critical analysis of the term, e-learning with the following definition:

"E-learning is the collection of teaching – and information packages – in further education which is available at any time and any place and are delivered to learners electronically. They contain units of information, self-testing batteries and tests, which allow a quick self-evaluation for quick placement. E-learning offers more lower level learning goals. Higher order goals like understanding, reasoning and (moral) judging are more difficult to achieve. They require an individualised interactive discourse and can hardly be planned" (Dichanz 2001)

Even though we do not totally agree with Dichanz that higher level learning goals cannot be planned, we agree that such goals are much more difficult to plan, and that most so-called e-learning programmes do not demonstrate attention to higher level learning objectives.

Similar reflections can be raised concerning the term, *'mobile learning'*. Again, learning cannot be mobile. Learners are probably more and more mobile, and they use mobile technology. In connection with this project we would describe NKI's main objective *'to design and trial out a learning environment for mobile learners and teachers'* maintaining the flexibility of distance education for learners on the move. These reflections are in line with Sariola et al. (2001):

"The term 'mLearning' has lately emerged to be associated with the use of mobile technology in education. It seems, however, that it is used in commercial purposes rather than as an educational concept. We wonder if the term is a commercial trick to market technology and educational services or if it is an emerging concept that educationalists should take seriously." (Sariola et al. 2001, p 1)

It should be noted that, although m-learning is a new concept, serving mobile learners is not a new idea. Again, distance education has a history of more than 150 years, where institutions has offered high quality education to learners *'free of time and place'*. This means, that if we are willing to accept the concept m-learning, distance teaching institutions have provided m-learning since its invention. For example, the history of Hermods, once one of the worlds largest correspondence institutions, tells that the original idea that resulted in establishing the institution in 1898 came when Hermods as a local language teacher in Malmö started to support one of his students who moved to another city (Gaddén 1973).

Thus, distance education institutions have provided m-learning for many years. In fact, the *'correspondence courses'* of the first generation of distance education could be studied at any time anywhere. Actually, the introduction of the desktop computer (and other learning technologies), which required the student to study at a certain place, often also at a certain time, reduced flexibility of distance learning. It is the introduction of mobile electronic equipment and communications technologies, which reintroduces mobility to the distance learner (and teacher). Kjell Askeland (2000) goes even further, and points to the fact that, if we disregard the need for an institution to plan and conduct teaching, mobile learning started when the printing technique was invented, and students could learn without coming to schools and universities.

Again, if we accept the term *'mobile learning' = m-learning'*, what is it? Most definitions take technology as the starting point, e.g. Quinn (2000-2001): *"...(mLearning)? It's elearning through mobile computational devices: Palms, Windows CE machines, even your digital cell phone. Let's call them information appliances (IAs),..."*.

Others define m-learning closely to distance education, Chabra & Figueiredo (undated): *"The ability to receive learning anytime, anywhere and on any device"*, while Harris (2001) combines technology and the flexibility concept of distance education in his definition: *"The point at which mobile computing and eLearning intersect to produce an anytime, anywhere learning experience"*.

Sariola et al. (Ibid.) discusses the concept, m-learning, from the perspective of educational theory, technology-based definition is obviously not sufficient, and also tries to include aspects of technology. They introduce the characteristics, *'portability,* i.e. the equipment is so light that we can carry the devices that we call mobile, *'wireless'*, there are no wires in the equipment, and *'mobility'*, we are moving when using the technology. Sariola et al. notes that it is the mobility that is most interesting from an educational viewpoint. Concerning mobility, they raise the question about *'who'* is moving, *'why'* and *'where'*. If moving is not related to the learning activity as such, why a person is moving might be irrelevant from an educational viewpoint.

However, it is the challenge of the educational institution to satisfy learning needs for people on the move (and we could add to support teachers who move to continue their tasks concerning student support). Sariola et al. notes that conducting educational activities while moving, might deal with *convenience*, e.g. rational time management or *expediency*, e.g. the person is moving to a place relevant for the subject studied. Both situations concern NKI when designing an effective and efficient learning environment for the distance learner, although convenience has been most focussed till now.

In this presentation it is hard to agree with the authors when they claim that mobile learning has existed for 150 years and is thus identical with 'distance education'. The advent of elearning, in which students studied the whole or part of a course in front of a computer screen, brought a new electronic dimension to distance learning, which cannot be bypassed. This was a wired computer environment and what is unique and innovative about mLearning is its elimination of the dependence on wiring and the harnessing of the global presence of mobile telephones to training and learning.

Flexible teaching or teaching in the 'extended classroom'

As stated earlier in this book there are two developments which are central to distance education; individual based systems, prevalent especially in Europe, and group-based systems prevalent in the USA and China. Fagerberg et al take up this theme in their next section:

A number of evaluation studies among distance and online learners at NKI demonstrate that students emphasize flexibility (see e.g. Rekkedal 1990, 1998, 1999).

In our view, distance education seems to develop in two quite different directions. The solution at one end of a flexibility continuum can be described as an individual, flexible solution allowing the student freedom to start at any time and follow his/her own progression according to personal needs for combining studies with work, family and social life – *'the individual flexible teaching model'*.

This model represents a generic development of the model of distance teaching institutions and applies normally media and technologies independent of time (and place), such as asynchronous computer communication, video, audio and printed materials. The model on the opposite end of the scale, *'the extended classroom model'*, assumes that the students are organised into groups required to meet regularly at local study centres and applies technologies such as video conferencing, satellite distribution, radio and television (Gamlin 1995).

In this connection we have chosen the philosophy for the development of Internet based education at NKI: *Flexible and individual distance teaching with the student group as social and academic support for learning.* NKI offers more than 400 courses and over 100 study programmes by correspondence based and Internet based distance teaching and recruits 10,000 students every year. These students may enrol to any course of programme or combination of courses at any day of the year and progress at their own pace. This flexibility does not exclude group-based solutions in co-operation with one single employer, trade organisation or local organiser.

It is also clear from NKI experiences that already many of our students and teachers have experience as mobile learners and teachers. Till now this has been restricted mainly to students and teachers carrying their laptops, possibly including communication via mobile phones.

Our main objective in this part of the project has been to extend the distribution of learning materials and communication to lighter equipment, specifically PDA and mobile phone. The challenge is then to develop the system and server side to present materials in ways suitable for PDA technology, find acceptable solutions for distribution of materials and for *administration to student, teacher to student/student to teacher and student to student communication.*

It is our aim in designing the environment for the mobile learner to extend and increase the flexibility of distance education, that to some extent took a step backwards when converting from paper based to online learning, where students largely were required to study at a place (and at a time) where a computer with access the Internet was available.

The authors then proceed with an in depth treatment of the nature of learning as it applies to mLearning and other possibilities.

Views on knowledge and learning

For NKI it was clear that the learning aims, content and teaching/learning methods in our online courses and programmes generally are far away from most e-learning courses. Most examples of m-learning experiments concern e-learning on mobile devices, often WAP and/or *'smart-phones'* (see e.g. Kynäslahti 2001, Kristiansen 2001).

To us, learning is a change in the student's perception of reality related to the problem areas studied and increased competence in solving problems in a field, ability to differ between focal and more peripheral questions, analytical skills and competence in using the tools within a field in appropriate ways. This means that learning results are shown in a qualitative change in the student's understanding, academic, social and technical competence. The learning is a result of active processing of learning material and solving problems individually and/or in groups.

This view is often different from what we can find in many so-called e-learning programmes, where knowledge often is seen as a larger amount of information or ability to recall and reproduce facts. In addition to cost considerations, this is why NKI in general has put little emphasis on using fancy effects in a behaviouristic pedagogical tradition, programmed learning and knowledge transmission (see Marton et al 1987, 1997, Morgan 1993 on students' conceptions of learning, deep level and surface level approaches to learning). We also hold the view that learning is an individual process that can be supported by adequate interaction and/or collaboration in groups (Askeland 2001). With these considerations in mind the NKI solution for designing and trying out a new learning environment for online learners applying PDA and mobile communication seemed to be a sensible one. Our considerations and decisions are discussed below.

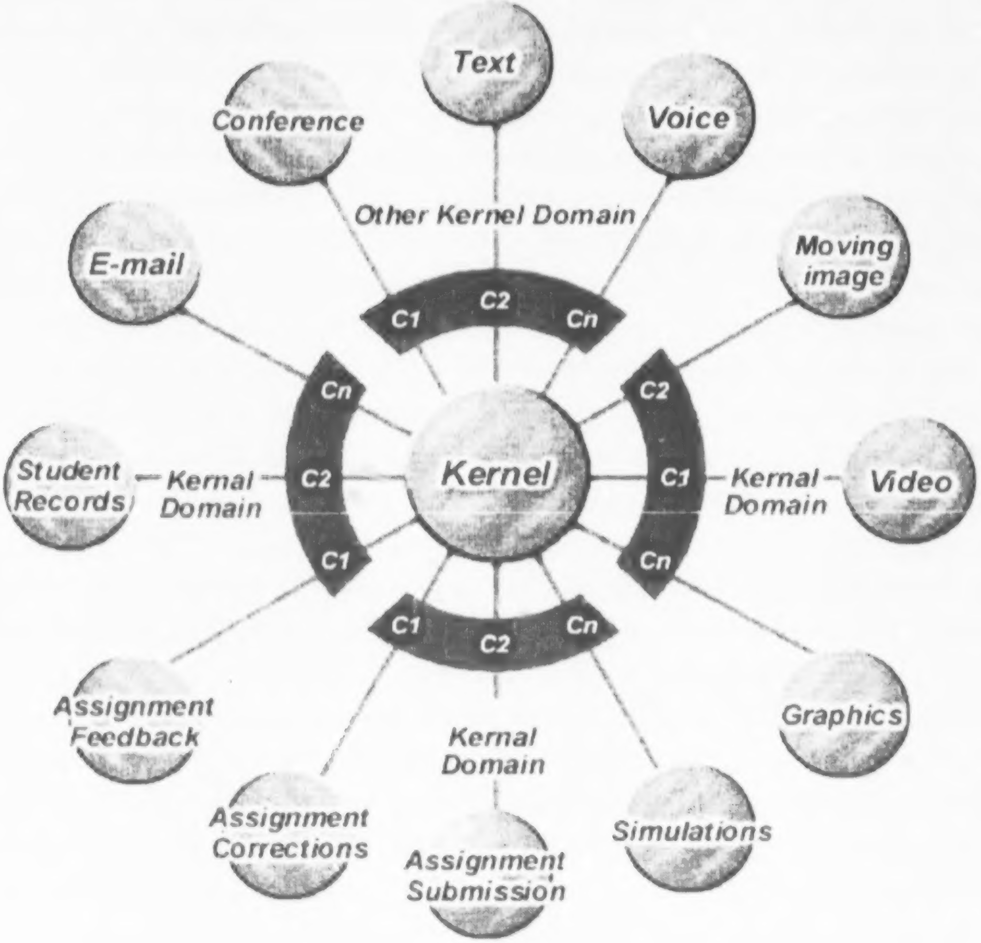
Internet based education at NKI today

The authors then present the experience of their own institution in the field of e-Learning and the transition to m-Learning.

NKI was probably the first European online college, and it has offered distance education online every day since 1987. Few - if any - online colleges in the world has been longer in continuous operation.

NKI Distance Education has today well above 200 courses and more than 60 complete study programmes on the Internet. October 2001 we had 3,000 registered active students. There will be more than 6,000 new course enrolments this year (2001). Contrary to many other educational providers where the Internet is used as a supplement to face-to-face teaching or other forms of distance education, we have followed the philosophy that in principle all communication can be taken care of through the Internet, and ideally no obligatory physical meetings should be required. (This does not mean that the students are not free to communicate by post, phone or fax or that study materials may include print, audio or video technologies.)

In connection with a previous EU Leonardo projects managed by LM Ericsson we described the programme and distribution system in Internet based learning as a '*Multimedia World Wide Web Kernel for Distance Education*' (http://www.nki.no/eeileo/) with the following elements:


Text
Conference
Voice
Other Kernel Domain
E-mail
Moving image
C1
C2
Cn
Kernel
Student Records
Kernal Domain
Kernal Domain
Video
Assignment Feedback
Kernal Domain
Graphics
Assignment Corrections
Assignment Submission
Simulations

Model of the Multi Media Kernel for Distance Education.

In designing the learning environment with the mobile learner in mind, all these aspects and functionalities have to be taken into account. However, in this first pilot experiment we have not focussed on multi-media materials. Extending the functionalities to more multi-media content adapted to the PDA should be a main objective for another project.

Development and Design of the Environment for the Mobile Learner Applying the Compaq iPAQ

As mentioned above, the aim for the NKI project team was to adapt a course so that it could be used on a wireless handheld device, in our case the Compaq iPAQ Pocket PC. After some discussions we have chose the course *'The Tutor in Distance Education'* for this project. In addition, we also put some effort into adapting the course *Spice 601, Specialization Program in International Online Education*, to the Pocket PC. This was mainly done to demonstrate a course in English for the Leonardo project team.

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These courses were already developed and distributed as courses from the NKI Internet College. The challenge was to design a solution to try out for mobile learners.

Some background information on the Compaq iPAQ

This device is a handheld pocket PC that puts the power of a desktop PC in a sleek little to-go box that gives access to Microsoft Pocket applications like Internet Explorer, Outlook, Word and Excel. Among this software is also Microsoft Reader with Clear Type, which is one of the technologies that we wish to try out in the project. It is also possible to install third party software. One can synchronize the device with one's desktop PC to read e-mail, view attachments, update the calendar and the device can easily connect to a mobile phone via cable, infrared or bluetooth (3870 version) for online browsing. (See http://www.compaq.com/products/handhelds/index.html for more details.) The screen keyboard is acceptable for short notes. However, many users would prefer to connect to Pocket PC with a foldable keyboard for more efficient writing. At the time of writing (December 2001) available keyboards are far from ideal concerning supporting Norwegian characters.

Studying online and offline

In line with the above discussions on learning and studying, most NKI courses are not designed to function as online interactive e-learning programmes, although some parts of the courses may imply such interaction with multi-media materials, tests and assignments. The courses normally involves intensive study, mainly of text based materials, solving problems, writing essays, submitting assignments and communicating with fellow students by e-mail or in the web based conferences. This means that most of the time the students will we offline when studying. From experience we know that the students often download content for reading offline and often also print out content for reading on paper.

It should also be emphasized that we assume that the NKI Internet students normally will have access to a desktop or laptop computer with Internet connection. This means that the equipment and technologies used when mobile are additions to the students' equipment used when studying at home or at work.

When planning for the m-learning environment the NKI project team had long discussions whether to develop the learning materials for online or offline study. Taken the above experiences and also cost considerations concerning mobile access to online learning materials, we concluded that the learning environment should include the following aspects:

- Technology:
  - Pocket PC
  - Mobile phone
  - Portable keyboard

NKI distance student reading comments from his tutor in the garden of his hotel on business in Rome using PocketPC, portable keyboard and mobile phone.

Learning content and communication:

- Learning content to be downloaded on the mobile device to be studied offline. Downloaded content to include all course materials:
  - Content page
  - Preface
  - Introduction
  - All study units
  - Resources (articles on the web, references to other resource materials)
- Online access to the discussion forum with the possibility of as quick as possible access for reading in the Forum and writing contributions
- E-mail for individual communication with tutor and fellow students and for submitting assignments. Assignments may be submitted as text-based e-mail or as Word or Text attachments.

Before taking the decision on distribution of course content to students via the Pocket PC, we analysed three alternative solutions that were discussed in depth. The discussions also included viewpoints on which materials and study activities were suited for offline or online work.

The authors then describe central decisions on the type of system they would design for the Compaq iPaq:

3 alternative solutions for distribution of course content

The 3 main solutions for distributing content were:

1. The AvantGo Mobile Internet service
2. Online access via mobile telephone to the entire course
3. 'Download-on-demand' version

Solution 1: The AvantGo Mobile Internet service

Technically we could choose the solution were the student easily could download the entire course content trough *'The AvantGo Mobile Internet Service'*. From the AvantGo website:

"The AvantGo Mobile Internet service provides free interactive and personalized content and applications to your handheld device or Internet-enabled mobile phone real-time via wireless connection or desktop synchronization. With AvantGo you can seamlessly transition between wireless and offline modes to browse your favorite websites on your mobile device or select from our more than 1500 brand-name content and application channels for up-to-date news, financial, travel, entertainment, sports information and much more.

The AvantGo Service allows the user to subscribe to a large number of channels of different categories. AvantGo offers a range of products for the synchronizing of PDAs. Including a range of hosting services. Unfortunately the hosting services are only suitable for the delivering of typical news channel information such as CNN headlines or stock quotes. These services are priced according to how many users use the service each day. AvantGo then uses advertising and revenue from the information provider to generate income. It is up to the information supplier to generate their own income based on these services. The hosted services also do not cover NKI Distance Education needs of personalized content and user interaction.

To be able to deliver content to PDAs via AvantGo we will be required to install our own AvantGo server, and then deliver content via this server to PDAs. AvantGo call their server Mbusiness server. The server is capable of being connected to our current web application (SESAM). And allow us to use our own database of user names and passwords, via a connection to our LDAP server for authenticating users. This would allow NKI to deliver customized content to each user. When using the Mbusiness server it is also possible to cater for user interactions. In that case a user could write a submission to the forum system and the next time the PDA was synchronized, the submission would be uploaded to our server

The Mbusiness server is available for many operating systems, including MS-Windows, Linux and SUN Solaris. All communication with the server is encrypted for security.

AvantGo's pricing policy is based on the value the server product will add to the purchasing enterprise. So the price is highly variable. It is not possible to get a 'definitive' price for the Mbusiness server without AvantGo evaluating how much 'value' the server will add to our organization. However, we were able to get a general guideline. The Mbusiness server would typically costs around 75,000 euros for a 250-user intranet. These are costs that would not be acceptable for use with NKI Internet students.

Solution 2: Online access via mobile telephone to the entire course

This is perhaps in principle the preferred solution. However, it requires higher speed and lower prices than we could find in Norway in 2000. It is also the most complex solution. An online version requires that we would have to redesign the entire site to fit the Pocket PC format. Before doing this we would have to make a cost-benefit analysis in front to see if the solution really is worth the effort. The other important issue is the availability of mobile communication technology and pricing. In this project we are using the Ericsson R520 and Ericsson T39 mobile phones connected with the PocketPC. These phone supports GPRS, General Packet Radio Services, and HSCSD (higs-speed circuit switched data). So far in the project our experience with this technology is mixed. It proved quite difficult to set up and connect via GPRS, and the prizing policy chosen by our Norwegian GPRS providers makes it all to expensive to use. One pays no subscription fees, however, the amount paid Mb of information transferred is presently not acceptable. For data up to 1Mb one pays 0.10 NKR pr. Kb and 0.025 NKR pr. Kb for data exceeding 1Mb.

Solution 3: 'Download-on-demand' version

We have developed two different "download-on-demand" versions. The first one consists of a set of zipped HTML files, which one may download to the desktop PC, unzip and synchronize with the PocketPC. The second consists of a set of ready to use Microsoft Reader files, which also are synchronized to the PocketPC. These files are available from within the web course.

At this stage of the project we focused on this alternative. The HTML version is using *Internet Explorer* to browse the course material offline. The other version is also an offline version, using the software, *Microsoft Reader with ClearType*.

The choice of solution 3 was partly a result of limited time and resources available at this stage of the project. Solution 1 needs more research to *'the most ideal'* solution for the future, i.e. to offer a complete PDA adapted version based on the same learning materials available in the web course for standard PCs. The principle of *'one file many versions'* (html, pdf, reader, etc.) is achievable trough the use of XML). Presently, through our preliminary analyses we found that explore opportunities, limitations and cost/benefit. Solution 2 would perhaps be there were too many limitations in mobile technology regarding transfer capacity vs. cost to be able to carry out the experiments that we wished to do. Solution 2 would also, as mentioned above, require a complete site redesign of the NKI Distance Education website.

The reason for supplying two alternatives of content is that we as part of the empirical testing are interested in examining attractiveness and user friendliness of the different solutions for the student. The student can manipulate the Microsoft Reader content by the possibility of *bookmarking, adding highlights, notes and drawings and look up words directly in the PocketPC Dictionary*. This means that the students can use the materials actively in ways that we recognise from students' use of print materials and their personal notes. The student is, in other words, able to 'make the materials his own' while studying. It is reason to believe that these functionalities may help students organising the materials cognitively and support learning and remembering.

The decision to go for the choice of downloading content for offline study was based on previous experiences and also the following considerations: NKI Internet students study mainly offline. Communication concerns discussion with fellow students in the academic forums, cooperation on projects and group assignments, and individual communication with other students – and, most important, according to our evaluations (see e.g. Rekkedal & Paulsen 1997), communication with the tutor including submission of assignments with correction and feedback. All our analyses concluded that the students will have all these possibilities available on their desktop or laptop PCs, including online interaction with the learning materials.

When mobile – and using mobile technologies – it is generally satisfactory for the student (and the tutor) to have the course content available to study on the PocketPC. In addition, the following communication possibilities are necessary. When mobile, the student must be able to:

- Access the course forum to read messages
- Access the course forum to submit contributions to the discussions
- Send e-mail to fellow students, to the teacher and to administration (study advisor)
- Receive e-mail from fellow students, from the tutor and from the administration
- Submit assignments by e-mail including attachments
- Receiving assignments corrected and commented on by the tutor including attachments

To access e-mail and discussion forums, mobile phones will be used. We plan that in future versions it will be possible to synchronize discussions via the student's desktop or laptop PC.

This software/technologies chosen are described in more detail below.

Development of courseware for the Compaq iPaq

The authors now describe the choice of courseware for the m-Learning development on the Compaq iPaq and the methodologies used in the development of this courseware.

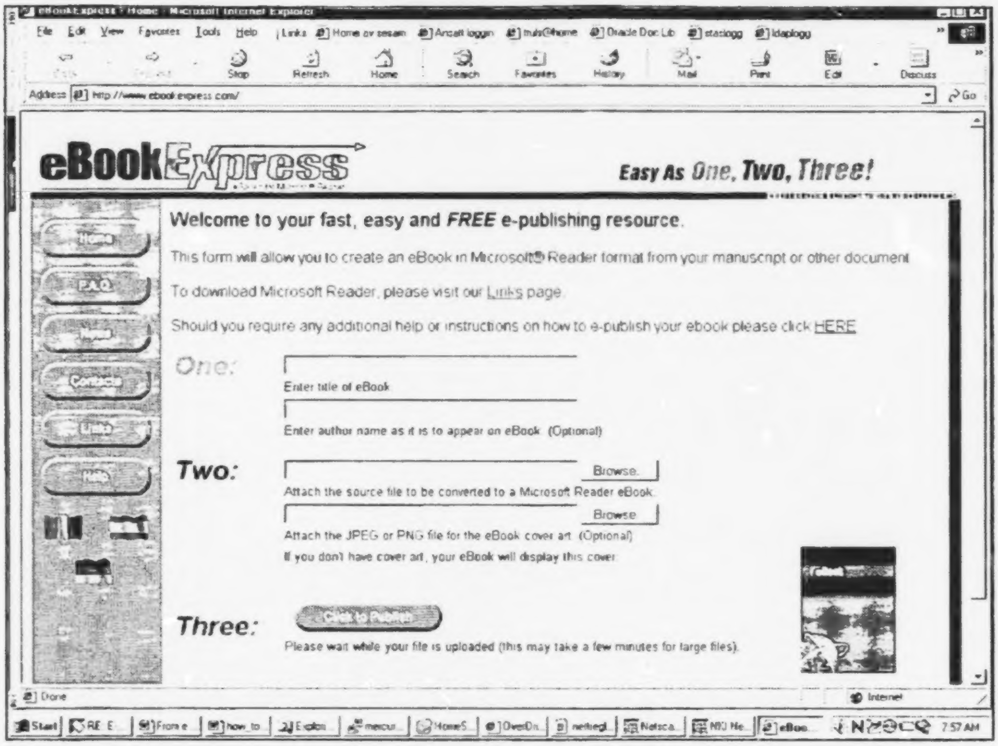
We chose a course previously developed for Internet/web based learning, '*The Tutor in Distance Education*' as courseware for this project. This course is one of our many ongoing Internet courses and therefore already available in a HTML version. Thus it was relatively easy to adapt the existing version of the course to the iPAQ since MS Internet Explorer is the browsing tool used. The main part of the adaptation was to create directories and file structures that insured that all content were present and worked as intended.

Some modifications had to be done, e.g. the table of content had to be changed, so that all links to introductions, study units, articles etc. could be placed on one page. The Content Page also contains links to examples of course pages such as class list, forum page, the student's personal NKI college page and others. Students can also a link to the presentation of their tutor with contact information. The course includes reference links to many external resources, which also are available on the PocketPC, but accessible only when online through the mobile phone. The course also includes a number of articles available at the NKI Internet College Pages. We chose to include the whole library of distance education research reports, articles, conference papers etc. available on the NKI pages. This was done mainly because the course content concerns distance education pedagogy and didactics, thus as the storing capabilities of the iPAQ was sufficient, we considered this as an extra academic service.

As mentioned, the HTML version applies Microsoft Pocket Internet Explorer that is a web browser with far less functionality than the full scale PC version.The other version developed for the project uses Microsoft Reader on the Pocket PC as 'browsing' tool.

Microsoft Reader with ClearType is one of the programmes available to read e-books or content in the *.lit file format (MS Reader file format). Microsoft has developed Microsoft Reader with ClearType that enhances display resolution by as much as 300 percent by improving letter shapes and character spacing, making them appear more detailed, more finely crafted, and more like printed fonts. This gives powerful digital advantages like integrated dictionary support and electronic annotations, while honouring the best traditions of typography to ensure proper kerning and leading, correct margins, and line justification, to name a few. The software also gives the opportunity to read e-books, Pocket Dictionaries etc. to downloaded from the Internet and synchronized to the PocketPC via the PC.

There are several methods to produce materials in the Microsoft Reader format. One may create on-the-fly Reader files via publishing websites like eBookExpress: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File Edit View Favorites Tools Help
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Stop Refresh Home Search Favorites History Mail Print Edit Discuss
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Please wait while your file is uploaded (this may take a few minutes for large files).

The eBook Express Home Page.

It is possible to outsource the entire or parts of the converting process. Several e-book consulting and content conversion services are available and offering services ranging from document conversion to complete e-commerce solutions. Overdrive is one example of a firm that offer ePublishing solutions, http://www.overdrive.com/ .The software builds the e-book, page-by-page, according to individual preferences to suit the device one is using.

One may also download software that converts publications into Reader files/e-books according to individual preferences. One of these is ReaderWorks. This is a third-party software recommended by Microsoft developed by OverDrive Inc. ReaderWorks is available in three versions, Standard, Publisher and Professional. The Standard version is freeware with less functionality than the Publisher and Professional versions. OverDrive and Microsoft also provides a software development kit (SDK) that software developers can use to build tools that generate Micorosoft Readerfiles.

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Microsoft also offers an add-in functionality for Microsoft Word that makes it possible to convert a Word document to Reader format.

We have in the project produced a version of the learning materials for Microsoft Reader using the Standard version of ReaderWorks from OverDrive Inc. This version is a freeware application with some limitations regarding commercial sale and distribution. It also lacks the opportunity to provide cover pages and marketing information.

ReaderWorks Standard includes tools to convert html, text and image files to Reader format. It also allow for making a table of content based on heading formatting of HTML documents. Our experience so far is that this is a very well functional tool that also is quite easy to use. It has an intuitive user interface with many different options and functions. We had some problems with empty meta-tags that made the conversion fail. The software also showed some problems with documents containing internal style-sheets and script language. These errors caused the conversion to fail. The HTML code causing these errors had to be manually corrected. The software supplied good reports on what kind of errors arising and where they occurred.

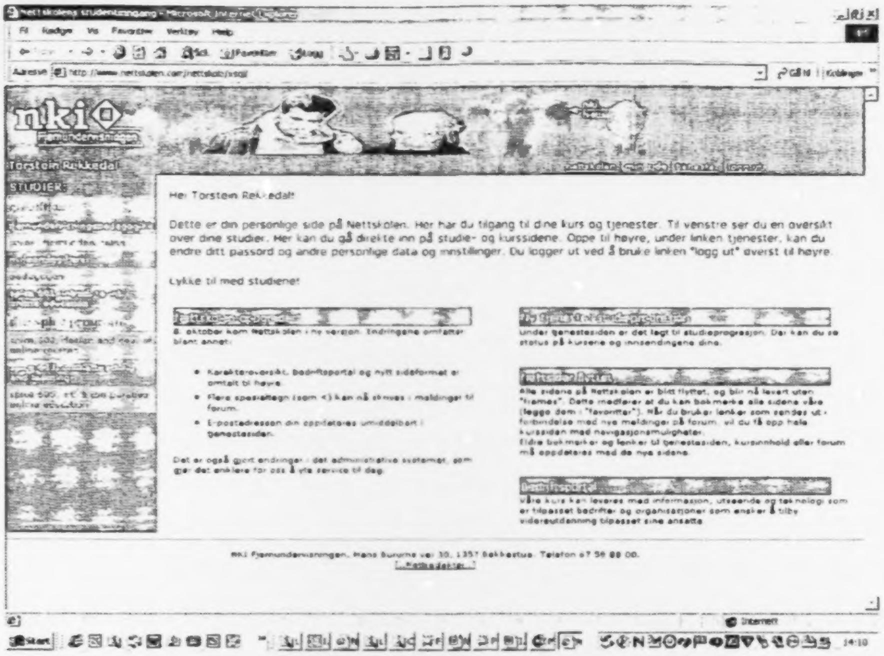
The Solutions Exemplified

In this important section the authors describe the differences in presentation of the wired version of the course for e-Learning and the changes that are met in using the same materials in a mobile learning environment.

Learning materials accessed from the PC

As described before all NKI Internet students, whether studying a course with a mobile supplement or not, will access the course materials and communication solutions via their ordinary PC at home, at the workplace or elsewhere. Course content for the mobile supplement is downloaded to the PC and synchronized to the PocketPC, while all the communication activities can be carried out through the PocketPC and the mobile phone when on the move.

Below we shall illustrate the practical solutions through a number of screen shots of the course as it looks on the PC and on the Compaq iPAQ.



Torstein Rekkedal

STUDIER:

Hei Torstein Rekkedal!

Dette er din personlige side på Nettskolen. Her har du tilgang til dine kurs og tjenester. Til venstre ser du en oversikt over dine studier. Her kan du gå direkte inn på studie- og kurssidene. Oppe til høyre, under linken tjenester, kan du endre ditt passord og andre personlige data og innstillinger. Du logger ut ved å bruke linken "logg ut" øverst til høyre.

Lykke til med studiene!

8. oktober kom Nettskolen i ny versjon. Endringene omfatter blant annet:

- Karakteroversikt, bedriftsportal og nytt sideformat er omtalt til høyre.
- Flere spesialtegn (som <) kan nå skrives i meldinger til forum.
- E-postadressen din oppdateres umiddelbart i tjenestesiden.

Det er også gjort endringer i det administrative systemet, som gjør det enklere for oss å yte service til deg.

Under tjenestesiden er det lagt til studieprogresjon. Der kan du se status på kursene og innsendingene dine.

Alle sidene på Nettskolen er blitt flyttet, og blir nå levert uten "frames". Dette medfører at du kan bokmerke alle sidene våre (legge dem i "favoritter"). Når du bruker lenker som sendes ut i forbindelse med nye meldinger på forum, vil du få opp hele kurssiden med navigasjonsmuligheter.
Eldre bokmerker og lenker til tjenestesiden, kursinnhold eller forum må oppdateres med de nye sidene.

Våre kurs kan leveres med informasjon, utseende og teknologi som er tilpasset bedrifter og organisasjoner som ønsker å tilby videreutdanning tilpasset sine ansatte.

NKI Fjernundervisningen, Hans Burums vei 30, 1357 Bekkestua. Telefon 67 58 88 00.

Screen shot of the tutor's 'Personal page' as it looks on the PC.

After logging into the NKI Internet College with user name and password, the user (tutor or student) opens the person's individual 'Personal page'. This page contains general information and lists the courses and programmes the person has access to. On the screen above the tutor has access to *'m-learning lærer'*, which is the course developed and to be tried out during the first phase of the project. The course title links to the Course Front Page.

The course front page links to:

- The course content on the server
  - Preface
  - Introduction
  - Study Unit 1
  - Study Unit 2
  - Study Unit 3
  - Resources
- Information about copyrights
- Tutor and class list
- The course forum

In addition the m-learning version has a link named *'Pocket PC'*, which links to a page containing all necessary information for downloading the content in the two versions, HTML format and Microsoft Reader format.

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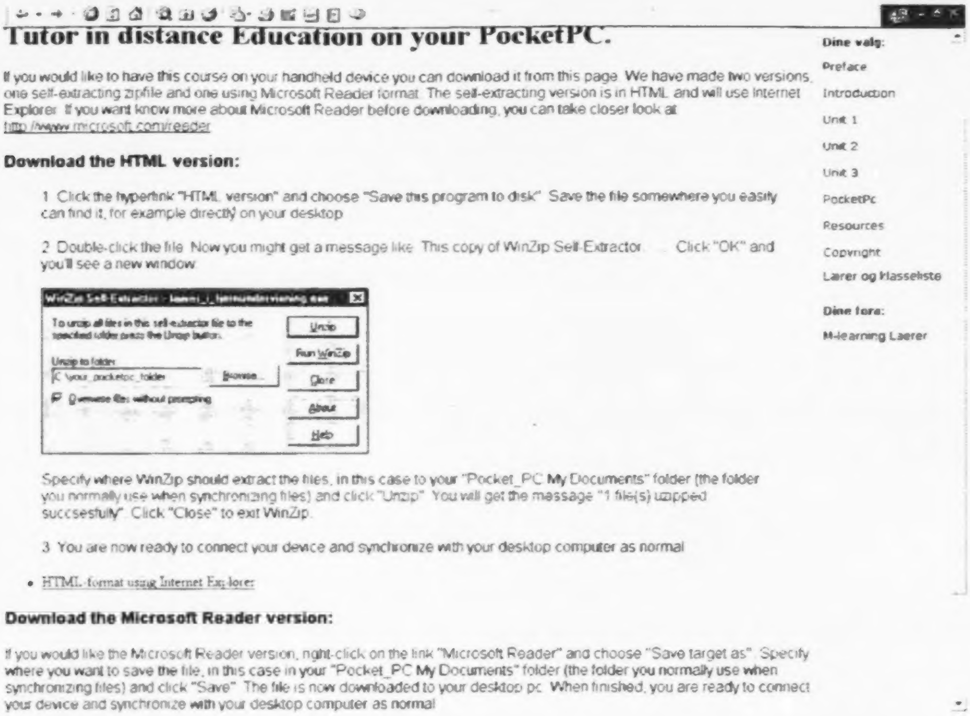

Tutor in distance Education on your PocketPC.

If you would like to have this course on your handheld device you can download it from this page. We have made two versions, one self-extracting zipfile and one using Microsoft Reader format. The self-extracting version is in HTML and will use Internet Explorer. If you want know more about Microsoft Reader before downloading, you can take closer look at http://www.microsoft.com/reader

Download the HTML version:

1. Click the hyperlink "HTML version" and choose "Save this program to disk". Save the file somewhere you easily can find it, for example directly on your desktop.

2. Double-click the file. Now you might get a message like: This copy of WinZip Self-Extractor ... Click "OK" and you'll see a new window.

To unzip all files in this self-extractor file to the specified folder press the Unzip button.

Unzip to folder: C:\your_pocketpc_folder

☑ Overwrite files without prompting

Specify where WinZip should extract the files, in this case to your "Pocket_PC My Documents" folder (the folder you normally use when synchronizing files) and click "Unzip". You will get the message "1 file(s) unzipped succsesfully". Click "Close" to exit WinZip.

3. You are now ready to connect your device and synchronize with your desktop computer as normal.

- HTML-format using Internet Explorer

Download the Microsoft Reader version:

If you would like the Microsoft Reader version, right-click on the link "Microsoft Reader" and choose "Save target as". Specify where you want to save the file, in this case in your "Pocket_PC My Documents" folder (the folder you normally use when synchronizing files) and click "Save". The file is now downloaded to your desktop pc. When finished, you are ready to connect your device and synchronize with your desktop computer as normal.

Page for downloading course materials to the PocketPC.

Learning materials and communication on the PocketPC

The learning materials downloaded and synchronized to the PocketPC are presented as complete HTML files, and are, according to our subjective opinion, satisfactory for reading on the PocketPC screen. This will be evaluated during the try out.

The screen shots of the PocketPC are photographed using a digital camera. The results are not perfect, but give a reasonably good impression of how they look.

Below is presented the course content files as they appear downloaded in the HTML version:

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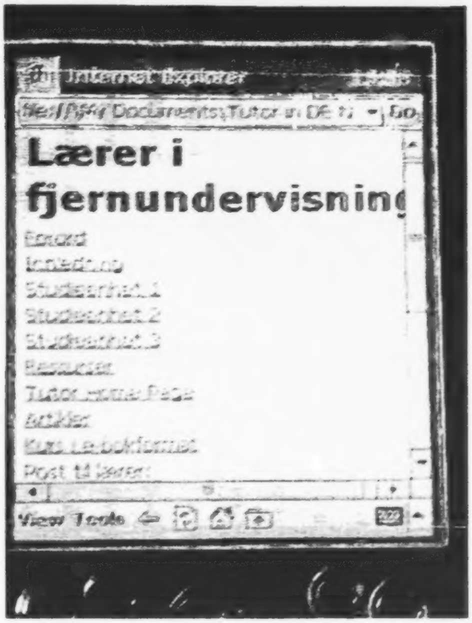

Internet Explorer

file://My Documents\Tutor in DE N

Lærer i fjernundervisning

Forord
Innledning
Studieenhet 1
Studieenhet 2
Studieenhet 3
Ressurser
Tutor Home Page
Artikler
Kurs i e-bokformat
Post til lærer

The Table of Contents Page on the PocketPC.

The hyperlinks brings the student to the course content files. The last link seen at the screen, *'Kurs i e-bokformat' (Course in e-book format)* opens the Microsoft Reader with a second full version of the course. The Content Page also has links (not seen on the screen) that opens the PocketPC e-mail programme or connects directly to the course online for reading and contributing to the course forum.

Internet Explorer 16:01

Name:
Position:
Postal address:

Go
View Tools

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Tutor Presentation (Tutor's Home Page) as accessed online with the PocketPC or downloaded and synchronized to the PocketPC.

While the course content is presented in formats adapted to the screen of the PockePC, the pages above are shown as they appear with the present solution (without having redesigned the materials on the server to fit the PocketPC). However, with some scrolling the pages are readable.

As we have discussed above online studying in this version is mainly related to communication including participation in Forum discussions.

The authors then proceed with their conclusion on the provision of mobile learning environments for learners so far.

Conclusion course presentation and communication

At the present stage and with present technological limitations the NKI project team decided that we had found an acceptable solution for presentation of course content and facilities for studying the learning materials, for solving assignments and submission of assignments to the tutor. Sending and receiving e-mails also functions satisfactory.

It is the empirical try out that hopefully will give answers to how our solutions actually are accepted in practice. In connection with the second phase of the project, we will parallel to the empirical research look at possible solutions for redesigning the site to make the learning materials better adapted for online access and interaction from mobile equipment.

In this paper we have described the preparatory work, internal discussion and analyses and the development work concerning preparing for trying out a learning environment for mobile learners within the teaching and learning system of NKI Distance Education. The NKI Internet College is defined as the total system for Internet based distance education courses. The work during 2001 is carried out in close cooperation with the other partners in the project.

The solution is based on the assumption that students defined as *'mobile learners'* have access to the NKI Internet College through a standard PC and Internet connection, and that the mobile part is seen as a supplement for students when on the move. Our technical requirements was that the mobile learning platform had to allow more advanced presentation and communication possibilities than possible through the WAP phone, concerning storing capabilities, use of colours and graphics and size of files. The decision was taken to develop learning materials, i.e. complete courses for handheld PDAs/PocketPC and mobile phone for connection to the Internet. The solutions are supposed to be generic and based on state of the art technology and also representing technologies that would give experiences of value for future assumed probable developments in software and hardware. The actual equipment used as basis and trials during development was Compaq iPAQ and Ericsson T39 and R580.

One course, *'The tutor in distance education'* was chosen as the first practical case in developing materials and communication solutions for the mobile learner. Before starting actual try outs, the project group feels that the technical solutions chosen constitute a good basis for experimenting and evaluating an environment for mobile learners in NKI Distance Education.

The authors then proceed with an indication of the next development of their provision of mobile learning environments for learners.

Planning the Try Out

We plan to try out the solution from early January 2002. Originally we wished to try out the course among ordinary students at NKI. We have found that access to equipment among our ordinary students for the time being is too limited. Thus, the fist trial will be carried out in a partly real and partly simulated situation where one member of the project team will teach the course to an internal group of NKI employees, some members of the project team and some participants working in other projects and related areas. For the try out we have purchased 10 PDAs and a few mobile phones.

We will evaluate the results through the process applying qualitative research methods, such as diaries, interviews and discussions in the academic Forum focussing on the aspects of the mobile learning environment. Aspects to be evaluated are:
Technical problems concerning downloading, synchronization ,communication with forum and e-mail
Studying on the move with the learning materials on mobile equipment (PDA and mobile phone)
Use of learning materials, usefulness of HTML solutions and e-book
Technology, such as use of screen and portable keyboards

The participants will be required to log experiences from the first experiences with the PDA and downloading till end of course, to study the materials and communicate with fellow students and participating in forum discussions via mobile equipment.

Technical working paper 2002, NKI Distance Education

NKI continued their contribution on the provision of mobile learning on PDAs with a study of the development of courseware and the software applied in the year 2002 by Stein Bredal and Truls Fagerberg in September 2002.

Development of courseware

In the 2001 experiment we supplied our students with two optional versions of the course, one in HTML and one in the Microsoft Reader (*.lit) file format. Based upon our evaluation results and experiences with Microsoft Reader from 2001, we decided to offer the 2002 course in the Microsoft Reader format only.

Microsoft Reader is a program for reading e-books or content in the *.lit file format (MS Reader file format). Microsoft has developed Microsoft Reader with ClearType that enhances display resolution and improved reading qualities. This also gives powerful digital advantages like integrated dictionary support and electronic annotations, while honoring the best traditions of typography to ensure proper kerning and leading, correct margins, and line justification, to name a few. The software also gives the opportunity to read e-books, Pocket Dictionaries etc. download from the Internet and synchronize to the PocketPC via the PC.

For the 2002 trial, have chosen to adapt one of the courses in the SPICE program, SPICE 603 Online Teaching and Learning. The Specialization Program in International Online Education (SPICE) comprises five six-credit (ECTS) courses about online education delivered internationally via the Internet. Successful completion of all five courses and exams qualifies for the Specialization Program in International Online Education Certificate (SPICE) which is awarded by NKI.

Producing e-books

In this second year we are using the same tools and technology used in year one, but we have upgraded our version of "ReaderWorks" to ReaderWorks Standard version 2.0.2.0215 and the PocketPC operating system(OS) to PocketPC 2002. Upgrading the PocketPC gave us better functionality regarding viewing tables in a document. On the old OS some tables in documents were not displayed properly. The new OS displayed it perfectly.

All our source files were originally produced in html format except one pdf – file that we had to convert to html because Reader Works can only handle html, word or plain text files as source files.

Microsoft Reader, e-book format, gives very limited options concerning layout and design features compared to word processors and html. Our html source files commonly use frames, tables and illustrations as design elements. All frames had to be removed by re-building all documents, and all tables used as design elements were removed. Tables used as "ordinary" tables or as markings around text were kept when possible, otherwise they were rebuilt or split to fit the screen size at the PocketPC. One interesting point to note is that Reader for PocketPC handles large tables over several pages quite well, while Reader for desktop PC does not. We have experienced that on a desktop PC long tables tend to disappear at the bottom of a page.

Design elements such as illustrations were kept if they added value to the e-book, otherwise they were removed. Some illustrations were removed because they were too large to be displayed at the PDA and therefore added little or no value. Text attributes (font, style) and colors were converted without problems and kept as they were in the original documents.

All html source files have been cleaned up and edited to create one "look and feel". ReaderWorks use the heading tags to generate table of content(TOC) so all heading tags were checked and edited if necessary. The title tag < TITLE >A title</TITLE> were completely removed from the html source files because it generated an error when we produced the TOC. If the title tag was not removed, it included it self on the beginning/top of TOC. We have created our own style based on template styles for TOC to make it more readable and user-friendly for the PDA.

We also had to remove all tags in the head tag, <HEAD></HEAD>in each html file. This included not just the title tag, but also all meta tags because they generated errors when creating the Reader files and the process was not able to finish.

After completing all clean-up and adjustments , we were ready to produce our own e-book version of SPICE 603. ReaderWorks gives one the option of either creating files directly to the reading device, PocketPC, using synchronizing that stores the files directly into the <Pocket_PC My Documents> folder, or one could store them directly on to the desktop PC and chose were to store the files. We could not see any differences in these files whether stored on PocketPC or desktop PC.

It is imperative to produce a project file, ReaderWorks Project File (*.rwp). If one afterwards needs to edit the e-books, this project file will contain all materials such as original source files, setup files for table of content, properties, cover etc.

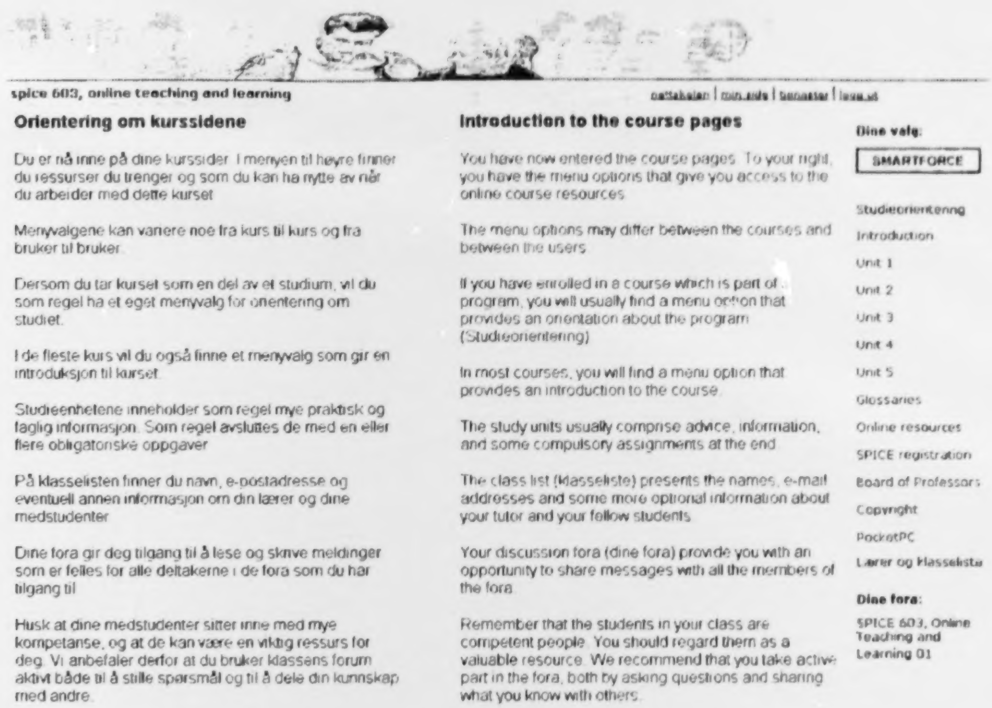
In this project we have made use of a limited freeware version of ReaderWorks called "ReaderWorks Standard". ReaderWorks is available in other versions with more advanced features. Vendor OverDrive, Inc. also provides an online service converting documents into e-book format. A ReaderWorks SDK(Software Development Kit) is also available. This SDK allows for instance to add a "Save As Microsoft Reader" component to software applications.

More information can be found at: http://www.overdrive.com/readerworks/

Course distribution

All NKI Internet students, whether studying a course with a mobile learning supplement or not, will access the course materials and communication solutions via their ordinary PC at home, at the workplace or elsewhere. Course content for the mobile supplement is downloaded to the PC and synchronized to the PocketPC, while all the communication activities can be carried out through the PocketPC and the mobile phone when on the move. After logging into the NKI Internet College with user name and password, the user (tutor or student) opens the person's individual 'Personal page'.

This personal page contains general information and lists the courses and programmes the person has access to. The course title links to the Course Front Page and gives access to the following page:



spice 603, online teaching and learning

[illegible] | [illegible] | [illegible] | [illegible]

Orientering om kurssidene

Du er nå inne på dine kurssider. I menyen til høyre finner du ressurser du trenger og som du kan ha nytte av når du arbeider med dette kurset

Menyvalgene kan variere noe fra kurs til kurs og fra bruker til bruker.

Dersom du tar kurset som en del av et studium, vil du som regel ha et eget menyvalg for orientering om studiet.

I de fleste kurs vil du også finne et menyvalg som gir en introduksjon til kurset.

Studieenhetene inneholder som regel mye praktisk og faglig informasjon. Som regel avsluttes de med en eller flere obligatoriske oppgaver

På klasselisten finner du navn, e-postadresse og eventuell annen informasjon om din lærer og dine medstudenter

Dine fora gir deg tilgang til å lese og skrive meldinger som er felles for alle deltakerne i de fora som du har tilgang til

Husk at dine medstudenter sitter inne med mye kompetanse, og at de kan være en viktig ressurs for deg. Vi anbefaler derfor at du bruker klassens forum aktivt både til å stille spørsmål og til å dele din kunnskap med andre.

Introduction to the course pages

You have now entered the course pages. To your right, you have the menu options that give you access to the online course resources

The menu options may differ between the courses and between the users

If you have enrolled in a course which is part of a program, you will usually find a menu option that provides an orientation about the program (Studieorientering)

In most courses, you will find a menu option that provides an introduction to the course.

The study units usually comprise advice, information, and some compulsory assignments at the end

The class list (klasseliste) presents the names, e-mail addresses and some more optional information about your tutor and your fellow students

Your discussion fora (dine fora) provide you with an opportunity to share messages with all the members of the fora

Remember that the students in your class are competent people. You should regard them as a valuable resource. We recommend that you take active part in the fora, both by asking questions and sharing what you know with others.

Dine valg:

SMARTFORCE

Studieorientering
Introduction
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Glossaries
Online resources
SPICE registration
Board of Professors
Copyright
PocketPC
Lærer og klasseliste

Dine fora:

SPICE 603, Online Teaching and Learning 01

Course Front Page with the PocketPC link on the menu.

All courses have a menu that gives access to study units, glossaries, resources etc. The menu may differ according to specific requirements for each course. In addition the m-learning version has a link named *'Pocket PC'*, which links to a page containing all necessary information for downloading the course. This is available from the standard version of SPICE 603 and can be taken advantage of by to anyone with access to mobile equipment.

Download page

This page contains downloading instructions and is divided into five separate downloading alternatives. The first section is called "Spice 603 Online Teaching and Learning" and contains the entire course except required readings for unit 1 - 4 (unit 5 does not have any required readings) and glossaries.

Required readings are divided into units, that are downloadable one-by-one. Students can decide for themselves if they prefer to download all content to their PocketPC or only those parts they need for the unit they are currently working on.

This course also contains a set of recommendations for further readings. They are however not offered as Reader files. Students will have to use their mobile telephone to log on to the Internet and download these further readings provided in html format directly to their PDA.

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From this course page one also has access to a discussion forum. For this second year experiment we have made some adjustment to the forum setup compared to year one. In year one we had just two main discussion areas called "administrative information" and "academic discussion". This produced a quite long list of threads and, it was not easy to figure out which threads belonging to which study unit. To help out on this we have now made several enhancements to the discussion forum.

Each study units were assigned their own main thread and we also added threads for support and general discussion on m-learning.

Some results

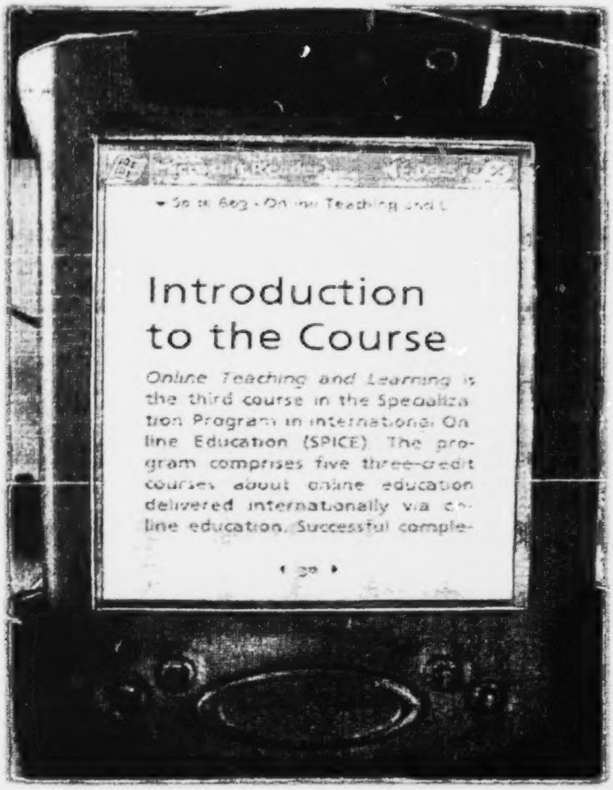
After downloading the necessary material and synchronised, the course is available using the Microsoft Reader application on their PocketPC.

When starting Microsoft Reader one begins with a Library page that gives an overview menu of all Reader files on our PocketPC. This start-up page also gives access to various features such as help, settings and sort.

"Settings" allows for adjusting font size, annotations etc. "Sort" offer different ways to organise the e-books, by title, by author, by size etc.

One drawback is that one can have only one library. We miss the option to have multiple libraries when enrolled to more than one course or course materials is very comprehensive. It would have been helpful to create one's own library to place course material in the correct place.

Below is a screenshot of the introduction the SPICE 603 on the PocketPC:



Introduction
to the Course

Online Teaching and Learning is the third course in the Specialization Program in International Online Education (SPICE). The program comprises five three-credit courses about online education delivered internationally via online education. Successful comple-

Screen shot of course page

During 2002 experiment 3 "real" students and tutor in the course SPICE 603 were equipped with mobile phones, PDA and portable keyboards. Additional students were enrolled in the course during the experiment period. From a technical point of view, our chosen methods of distribution, support and technology seems to have worked very well in a small scale environment. Student evaluations will be available and we will hopefully be able to gather views and experiences that will found a basis for future development.

From a developers point of view, it has been quite time consuming to convert all html files for a comprehensive course such SPICE 603. Other methods/techniques will have to be considered when(if) doing this on a large scale with many courses. ReaderWorks has shown to be an intuitive and effective converting tool easy to use and with quite good functionality provided even tough in the freeware version used in this project.

As a vague conclusion we might say that it is easy to generate e-books if one have "clean" source files that doesn't need much editing and is without graphics etc. Microsoft Reader presents text with acceptable good readability, useful functions such as highlighting of text and the possibility to add bookmarks and notes. We consider Microsoft Reader on a PocketPC to be a good solution and it seems to work well for our students and tutors.

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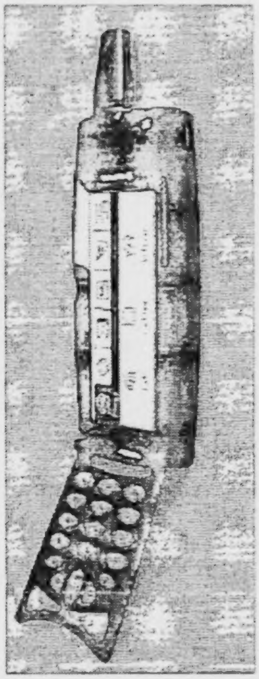
CHAPTER 7 mLEARNING ON THE SMARTPHONE (ERICSSON R380)

Proposal

This chapter deals with development of a didactic scenario for the smartphone R380 and the development of courses for running on it to demonstrate the differences between development for the smartphone and the WAP phone.

Illustration



Here is an illustration of the smarthone R380:

The functionality of the smartphone is described by Ericsson thus:

Unique functionality offers you an all-in-one mobile communications and organizational tool. (Mobile Phone + PDA + Mobile Internet Browser)

Email with your phone. Use your own ISP and securely send/receive corporate and personal emails (Supports Secure ID and Safeword).

WAP-browser. Browse your favorite WAP website for useful information including maps, forecasts and travel reports. Conduct m-commerce and online banking transactions. Supports WAP-profiles and WTLS (Wireless Transport Layer Security).

Fully-integrated PDA. Take your phonebook and calendar with you. Take notes and voice memos on the go.

Large, Graphics-rich Display. Easily view more information including graphic images, pull-down menus and charts.

Touch Screen. Stylus-based, Touch Sensitive Screen with Handwriting Recognition (JOT® by CIC) makes inputting text easy and natural. Even supports handwritten accents.

Voice Control Dialing and Answering. It responds to your voice.

Vibrating Alert. Discreetly notifies you of incoming calls.

Built-in Modem with Infrared (IrDA) Port. Get the information you need on the move, without wires, anywhere.

Infrared connection. Beam contacts to your colleague and exchange Virtual Business Cards.

PC Synchronization for office applications. Always have your most-recent information (Email, Calendar, Contacts, Notes and Tasklist) with you - no matter where you are.

Data Protection. The non-volatile memory makes it possible to keep data even if you lose power.

Melody Composer. Make your own tunes or choose among the 18 different tunes included. Melodies can also be sent by email, WAP or/and SMS.

Synchronization compatibility: MS Outlook 97/98/2000 MS Schedule+7.0 Lotus Organizer 4.1/5.0 Lotus Notes 4.5/4.6/5.0 (Lotus Organizer 5.0 is included in the kit)

Extras:
- Alarm
- Calculator
- Game
- PC Back-up/Restore
- Stylus-Based Virtual Keyboard
- World Clock displays home and local time
- Key lock
- Choice of 22 display languages

Network Supported Features Include: Automatic Time Zone (NITZ) Automatic Remote Configuration for Messaging and WAP Internet Services Call Wait / Call Hold / Call Forwarding / Call Transfer Conference Call

Caller Number Identification and Restriction, Combined list of successful, unsuccessful, received and rejected calls. International Roaming (World version covers larger areas) Short Message Service (SMS), send and receive. Voicemail USSD, SMS CB 50, RSMT Advice of Charge.

Ericsson presents the specifications of the R380 thus:

R380e brings together the functions of a mobile phone, calendar, address book and mobile Internet device with e-mail and WAP.

At first glance, it has the look, feel and performance of a regular high-spec mobile phone. But open the flip and you transform R380e into an advanced personal organizer with a large landscape display, an easy-to-use touchscreen keyboard and intuitive handwriting recognition for fast and easy input.

Send and receive e-mail and concatenated SMS1 wherever you are
and send faxes over SMS2. Get WAP the way it should be with a large, scrollable display and WAP 1.2.1 with WTLS class 2 enhanced security. That makes it safe to send confidential information such as credit card numbers and bank account details over the air.

R380's calendar and contact features are powerful and simple to use. The calendar has day, week and month views, and a handy task list. The contact feature allows you to store names, addresses, e-mail addresses, several phone numbers and more. Everything is quickly and easily synchronizable with your PC, making sure both devices carry exactly the same information. Plus there's a notepad, ink note feature, world clock, calculator, games and a useful voice memo feature

Here are the R380 specifications:

Dual band forGSM 900/1800 and e-GSM

Battery (Li-Ion 1200 mAh) with stylus. Travel Charger. 3 extra styluses. Desk Stand. RS 232 Cable. Classic Belt Case. Portable Handsfree with answering button. CD-ROM with PC synchronization software
Size: 130 x 50 x 26 mm
Weight: 164 g
R380e connects to: Windows®95/98/ME/2000/NT4.0 SP5 with minimum Pentium® 166MHz, CD player and 100MB free disk space
R380e synchronizes with: Most leading PIM applications (Microsoft® Outlook, Exchange and Schedule+ and Lotus® organizer and Notes)
Talk time* Up to 6 hrs
Standby time* Up to 130 hrs

Limitations

The R380 has a landscape display which greatly increases the screen space in comparison with normal mobile phones. Many will feel that it is still inadequate for successful study.

The lack of bandwidth available and the lack of memory are further difficulties in setting up a successful didactic system for the smartphone.

Almeida in her *The advantages and disadvantages of using WAP in developoing an mLearning course* writes:
Transporting data in the mobile networks of today, for example GSM, has been compared to 'Carrying an ice cube in a plastic bag in the desert heat of 40C'. The conditions of the mobile network are harsh. Hence, given these harsh conditions, it is essential to select an appropriate application environment and design the application for the mobile user and the challenges provided by the mobile network.
The mobile network is different, the bandwidth is narrow, and delays are greater than in the PC /Wired network which supports 2 Mbits per second. The mobile network in comparison provides resources of 9.6kbps for a user.
The challenges for developing an application for the mobile environment are mainly these obvious differences between the Mobile network and the Wired environment.

A mobile handheld device e.gMobile Phone or Smart phone is different to a PC/ Laptop. The screen size is small, the number of keys a user has access to is limited to 16 keys or less. The device also is limiting is memory storage, processing power and battery power.

Development of system for R380

Almeida in her *The advantages and disadvantages of using WAP in developoing an mLearning course* gives these guidelines for the development of a learning environment for the R380:
The application developer needs to consider the user when designing the mlearning course content and structure.
The following simple principles are recommended:

1. Keep it Simple
2. Avoid large amounts of data
3. Avoid underlined text as this will be mistaken for Links
4. Use Selection Lists for data entry
5. Consistency – place links in same place throughout application
6. Always provide link to Start page or Index
7. Use Titles on Cards to ease navigation
8. Use Tabloid format – headlines and summaries
9. Use short words

The only confirmation of usability is to test the application on sample users for ease of use, before the application is launched.

Pedagogical Issues

The main pedagogical issue to consider is the suitability of a course to the mLearning environment. Not all courses are suited to the mLearning environment. Purely technical and very practical courses are not suitable. However, short courses and mainly theory and information type courses are suited to the mobile learning environment. The learning environment can be enhanced by the use of quizzes to test knowledge, summary of main learning points, and interaction with other students and the tutor via telephony integration.

Development of courseware for the R380

The courseware for the R380 was developed using WML and WML script. Course development for the R380 is subject to the following: the R380 is WAP enabled, runs WML 1.1 and 1.2 and WMLS, the phone memory is 64 kbyte. A WAP server is required. For course development one needs the Ericsson WAP IDE 3.1.1 which can be downloaded from the WWW.

There are limitations to the complexity of content which cannot depend on streaming video or audio. Static black and white pictures have to be smaller than 300 x 95 pixels. Each learning unit has to fit into a file of an most 3.8 kbyte or 1½ A4 pages for both text and figures. No browser plug-ins are available.

The landscape format of the R380 smartphone is unusual for readers and the device does not support nested tables, nor italic typeface, and line and work breaks have to be set manually. Only a very small part of the courseware is visible on screen and thus a navigation bar is recommended for inclusion at the bottom of each page.

The provision of student support services is subject to the following restraints. *Call tutor* requires closing the WAP browser. A method, therefore, has to be designed to keep track of the page that caused the need to call the tutor. *Email tutor* is implemented by server side scripting. The method explained above is used to keep track of the page and makes it easy to navigate back to the last page read. *SMS to tutor* uses server side scripting and navigation according to email tutor functionality but the WAP site is basically insecure.

The tutor's response can be of three kinds: *Call student* - easy but may be expensive, *Email student* - easy and cheap, *SMS to student*. For mobile registration the student sends an email to the institution from the mobile phone. The data can be encrypted if necessary by using server side scripting. The institution then sends registration information to the student but this raises the question of how the institution knows that the student is the person identified in the information received. A solution is to check that the email address is valid by sending a test code first and waiting for response with ID and submitted test code.

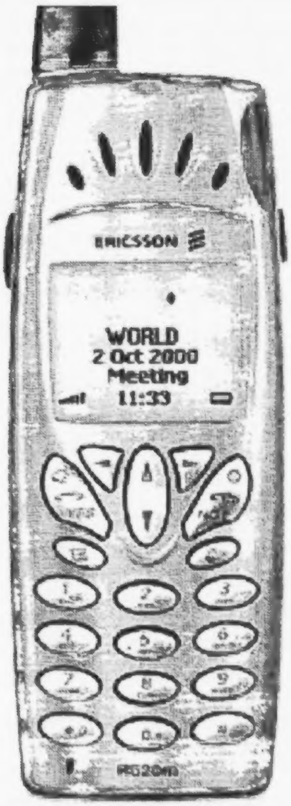
Student to student communication requires emails to the institution from the mobile phone in which the privacy status of the student is identified. If the request is for privacy no other student will see this student listed. If not, the student's email and/or phone number will be submitted on request to others. The question arises how does the institution know that the student is the person claimed in the data submitted. A solution is to let students decide whether they want their data kept secret or not.

CHAPTER 8 mLEARNING ON THE WAP TELEPHONE (ERICSSON R520)

Proposal

This chapter contains a full development of mLearning for the WAP telephone R520 and considers WAP telephony as a major element in mLearning.

Illustration



R520 WAP phone

The following outline of R520 functionality is provided:

The R520 is the first Ericsson phone to support GPRS which is a data ransmission technology that provides cost efficient IP (Internet Protocol) communication between mobile devices and Internet or intranet service hosts.

GPRS keeps you permanently connected to the Mobile Internet but only uses the radio link for the duration of time that it transfers data. R520 will transfer data at approximately the same speed as a fixed line modem.

R520 has built-in Bluetooth wireless technology. This ensures there is no need to have cables running between your mobile phone and your headset or mobile computer. Using this reliable and secure connection, the R520 can communicate with your Bluetooth Headset or mobile computer via a radio link instead of a cable when the two devices are within 10 metres of each other.

The WAP functionality of the R520 supports WAP 1.2.1 the latest version of the Wireless Application Protocol. WAP 1.2.1 is more secure as it supports digital signature technology allowing you to transact m-commerce in a secure environment.

The R520 supports the GSM frequencies used on five continents and in over 120 countries. When you turn on your R520, the phone automatically scans the network to determine if it is GSM 900/1800 or a GSM 1900.

With R520, your e-mails are never far away. R520 has a built-in e-mail client for sending and receiving e-mail. This allows you to connect to the e-mail account normally used on the corporate network, or another e-mail service as preferred. You can have more than one e-mail account in the phone, for example one for your business e-mails and one for your private e-mails. R520 also lets you have e-mail attachments, such as a photo from a digital camera transferred to the phone via an infrared connection.

The advanced calendar contained within R520 is central to its communication abilities. It has different views; month, week, day and a "tasks" list. It also supports week numbering and lets you create, edit and delete both appointments and tasks. Automatic synchronisation to a PC via WAP/Internet, Bluetooth™ or infrared technology is also possible

R520 features a hierarchical phone book in which you can save up to 511 contacts. For every contact placed in the book, you can store their name, home, work and mobile phone numbers, their pager number, their e-mail address and other information.

The R520 supports nine different input methods including three Chinese. This ensures that you can store names in the phone book and send and receive SMS messages in your own language: Latin, Arabic, Stroke. Pinyin, Bopomofo, Greek, Hebrew, Numeric, Cyrillic.

R520 features the very latest developments in voice recognition. It's no longer necessary to press a key to activate voice recognition. You can simply programme in a "magic word" (which can be any word of your choice) and then whenever you say this word the voice recognition function will activate automatically. With R520 you can use voice commands to change profile and answer and divert calls.

This innovative feature is found on the keypad and has the same functionality as the right button on a computer mouse and enhances usability by offering instant short cut menus.

This is predictive text input software that suggests words when you type in the first letter of the word you intend to write. It makes writing short messages easy and fast.

Limitations

The small size of the R520 screen is a major limitation. People are used to a computer screen and therefore have no objections to eLearning courses sitting in front of a computer screen. The small size of the R520 screen with just a few lines of text is a definite limitation.

The use of simulations, graphics both still and moving, and colour have become major features of both CR-Rom and eLearning courses and the inability of the R520 to reproduce these is another drawback.

Restrictions of memory and bandwidth will limit the downloading of course content in mLearning systems.

Almeida in her *The advantages and disadvantages of using WAP in developoing an mLearning course* gives these limitations for the development of a learning environment for the R520:
The main limitations of WAP today are related to the devices used and the mobile networks. The limiting factors of the device means that large amounts of data, especially graphics and animations are not recommended. Although, WAP supports images today only black and white images are possible. Colour Images and Animations will be supported in future releases of WAP.
Other limitations that the user perceives are not really WAP limitations but restrictions due to the mobile networks. Many users identify that WAP is slow and that it can take up to 2 minutes to access content Even with today's limitations it is possible to design applications well so that the best use of the scarce network resources are made. A well designed application can be accessed via WAP in less than 10 seconds.
The cost of using WAP is another disadvantage. The cost to upgrade to a WAP device and the additional cost to access content has limited WAP very much to the corporate user rather than the mass market.

Development of system for the R520

Almeida in her *The advantages* and *disadvantages of using WAP in developoing an mLearning course* gives these directions for the development of a learning environment for the R520:
Today there are more than 50 million mobile handsets that are WAP enabled. It is expected that all mobile handsets will be WAP enabled by the end of 2001. It is also predicted that by 2003/ 2004 there will be 1 billion handsets in the world.
Key players in Mobile Internet market support WAP. These include the Network Operators, Hardware Manufacturers, and Software Application Developers.

All the major handset manufacturers are committed to WAP and future mobile devices will support multiple technologies including WAP, GPRS and Bluetooth. As 3G (WCDMA, UMTS) is launched WAP will also evolve for these future networks.

Network operators are behind WAP and their support is clearly demonstrated by the deployment of WAP world-wide. There are more than 200 Operators that have WAP applications and services available to their customers. This is a huge investment in infrastructure, equipment and software applications and services.

Thousands of software application developers have been behind WAP and have created the applications and services for WAP. This commitment to WAP is clearly shown by the many thousands of WAP sites available in the word today.

Features of WAP (Personalisation and WTA)

When comparing the mobile network to the fixed network there seems to be many limitations, as already discussed. The mobile network also provides unique advantages or features such as the position or location of the device and personalisation (both user preferences and device capabilities).

The WAP language supports these features of Positioning and Personalisation. A WAP language component supports User Profiles which contains information on the user preferences and the device capabilities.

In addition, Telephony Integration is provided by the the Wireless Telephony Application, or WTA component. This allows a developer to easily integrate a telephone call in any WAP application. Thus the user can select a link e.g. Make Call to call a number from the application rather than exit the application and enter the telephone number

Optimisation of WAP languages

WML is Wireless Markup Language. It is based on HTML, but is optimised for mobile networks and small handheld devices. WML is used to create static content such as text to be displayed on the screen of the mobile device. WML, like HTML is a tagged based browsing language. However, WML has a limited number of tags and because of the limitations discussed earlier, these tags are sufficient for the purposes of creating mobile internet applications.

WML allows the developer to create the user interface which will be displayed on the screen of the mobile device. WML is straightforward and an easy to learn markup language. The type of content displayed on the mobile device screen such as text, links, images, data entry fields and selection lists are all easily created by the developer using the appropriate WML tag.

WMLScript is based on JavaScript, and is used to add intelligence to the static WML content. WMLScript is used for dynamic content such as data checks and error detection. When WMLScript is used together with WML it is possible to create powerful applications.

WML Script also provides the developer with access to standard libraries which offers re-use and efficient code. These libraries contain functions that are already coded, that can be called from WML or WML Script. They

include conversion of string types, browser access and dialog access directly from WML Script.
The WAP languages, WML and WMLScript are supported by the WTA (Wireless Telephony Application) Libraries. These public libraries allow the use to build into the application easy access to telephony functionality. This telephony integration means that the user can select a link e.g. Call Tutor to contact the tutor from the application rather than exit the application and enter the telephone number.
The efficiency of WML and WML Script is further enhanced by the binary encoding of the application sent over the Mobile Network. This means that a series of 0's and 1's is sent instead of text. This makes it very efficient over a narrow bandwidth.

Development of courseware for the R520

The course material for the R520 was designed using WML and WML script.

Almeida in her *The advantages* and *disadvantages of using WAP in developoing an mLearning course* gives these directions for the development of learning material for the R520
The application developer needs to consider the following areas of limitations when designing applications for WAP.

Network Challenges

The Bandwidth and Delay factors are the main network restrictions. For the optimisation of the application using WAP is an advantage, as WAP already takes these limitations into account. The developer, in addition, can design the application so that data to be sent over the mobile network is kept to a minimum. In the case of mLearning content, this can be achieved by structuring the content into useful pieces of information or snapshots. Summary type of information as opposed to pages and pages of text. Also images and graphics must be kept to a minimum or avoided as these take up a lot of memory usage on the devices.
Using the WAP design concept of 'Deck of Cards' encourages the developer to redesign the structure of mobile learning training material. A Card is the amount of data that will be displayed on the screen of the device, including any scrolling the user may do. A Deck consists of a number of Cards, that the Device will download from the mobile network. This is used appropriately can give a very positive user experience as navigating the cards is the deck is very fast, less than a second as the data is already stored on the device.

Device Challenges
The user interface and the memory and processing power are the main limiting factors of the device. The developer can overcome these by ensuring that most user interaction is via the navigation of links. Thus the user can access different modules of the course and related information via an Index of Links. When the user needs to enter data, this can be handled by the Select Lists which allows the user to make a selection on a number of options rather than type in large amounts of data (not recommended for mobile phones).

All of the design principle talked about in the previous section are also relevant, as the conciseness of information and the 'Deck of Cards' structure will help render the course content on the small screens of the devices to the user's satisfaction.

Usability Concepts

The application developer needs to consider the user when designing the mlearning course content and structure.

The only confirmation of usability is to test the application on sample users for ease of use, before the application is launched.

CHAPTER 9 STUDENT USE OF MLEARNING

Of particular importance in the development of a new technological sector for education and training is student usage and acceptance of the new learning environment. This chapter details experiences of mobile learning with real students in real learning situations.
The students are from the Ericsson International Training Centre in Ireland, from NKI in Norway, from the Fernuniversität in Hagen (the German Open University) and from the University of Rome III in Italy.

Student use in Ireland 1

Mobile learning in action

This is a report on the effectiveness of mobile telephones in training.

In early 2002 nine students on work experience at Ericsson Competence Solutions at Dun Laoghaire in Ireland were enrolled in the Ericsson *Wap Overview* course to be studied by mobile learning. All completed the course and filled in the international *Questionnaire on mobile learning* which is being used also in Norway, Germany and Italy.

Five of the participants used the Ericsson R520 mobile phone, which is a WAP phone with standard small screen. Two of the participants used the Ericsson R380 smartphone, with a larger horizontal screen. One participant used the Ericsson R320, a WAP phone that is an earlier model of the R520. One participant used the R520, the R320 and the Ericsson T39, a smaller WAP phone with a smaller screen.

Personal background

All participants gave their employment status as 'Student' and stated that they were under 24 years of age. 55% were male and 44% female.

77% had had one to three years of post-secondary education and 22% had had four or more years of post-secondary education.

All owned mobile phones, but only one owned a PDA (personal digital assistant) as well.

Student userfriendliness

Participants were asked if it was easy to use the equipment in this mobile learning course. These were the replies:

It was easy to use the equipment in this mobile learning course

11% Strongly agree
66% Agree

11%	*Uncertain*
11%	*Disagree*
0%	*Strongly disagree*

This is a satisfactory response rate with only 11% in disagreement.

The next question asked if the mobile learning experience was fun. This is a challenging question for a new and experimental area of training as it queries whether the course developers were able to create an attractive learning environment for the course participants and whether the participants found the new learning experience attractive. The answers were:

This mobile learning experience was fun

0%	*Strongly agree*
44%	*Agree*
22%	*Uncertain*
33%	*Disagree*
0%	*Strongly disagree*

In spite of the 33% who disagree, this is a challenging question about any new and experimental form of training and the replies can be regarded as satisfactory.

Another challenging question followed, asking whether the participants would enrol in another mobile learning course. It is one thing to study a new and experimental course, it is quite different once the course has been studied and the student knows the didactic environment and the challenges of the course structure. The replies were:

According to my experience I would take another mobile learning course if relevant to my learning needs

11%	*Strongly agree*
55%	*Agree*
22%	*Uncertain*
11%	*Disagree*
0%	*Strongly disagree*

Again the response of 55% in agreement with only 11% disagreeing is a satisfactory one.

Another tricky and challenging question followed. This asked if the participant would recommend mobile learning as a mode of study to friends or colleagues. To recommend a new and experimental mode of study to colleagues and others requires a definite level of commitment to the mode of study. The answers were:

I would recommend mobile learning as a method of study to others

123

0%	*Strongly agree*
66%	*Agree*
0%	*Uncertain*
33%	*Disagree*
0%	*Strongly disagree*

Here the answers are clearly distinguished. No one is uncertain and no one strongly agrees or strongly disagrees. 66% are in agreement and 33% disagree.

As one of the values of mobile learning is that it restores the 'study at any time, at any place' characteristic of distance learning which was attenuated by e-Learning's placing the student in front of a powerful wired computer for the period of training, participants were asked whether they studied the course at home or at the office or work station, or while travelling. Because of the way the course was organised 100% replied 'at the office or work'.

Didactic efficiency

If m-learning is seen as a development of e-learning, in which the state-of-the-art characteristics of e-learning today are enhanced and given new dimensions, it is important to know if mobile learning increases the quality of e-learning provision. Participants were asked:

Mobile learning increases the quality of e-learning

22%	*Strongly agree*
55%	*Agree*
22%	*Uncertain*
0%	*Disagree*
0%	*Strongly disagree*

No one disagrees and 77% either agree or strongly agree.

If mobile learning is to be accepted as a valid form of training provision, it is important that learning objectives can be met by mobile learning courses. Participants were asked:

Course learning objectives can be met by mobile learning

11%	*Strongly agree*
66%	*Agree*
22%	*Uncertain*
0%	*Disagree*
0%	*Strongly disagree*

No participants disagree and there are 77% who agree that course learning objectives can be met by mobile learning.

Among the difficulties to be met with mobile learning are questions related to the provision of course content. There are questions with the volume of content that can be provided in mlearning; with the structuring of the content in wml cards and decks; with the downloading of content from the server; with the display of content on mobile phone screens: the small standard screen of the WAP R520 phone and the somewhat larger rectangular and horizontal screen of the smartphone R380. Participants were asked how easy was it to download course content to a mobile phone:

Downloading course content was easy

44%	*Strongly agree*
22%	*Agree*
11%	*Uncertain*
22%	*Disagree*
0%	*Strongly disagree*

The replies indicate that this course was done on a test network which could be down at times or that the WAP gateway could be down and therefore the students could not log on. This could cause frustration but also provided real network experience of the use of mobile learning.

An important feature of the design of a didactic environment for mobile learning is the ability to provide communication to and from the tutor and the organisation providing the course. This is essential for feedback on student progress and for the solution of study and technical problems. In distance learning courses this is provided by correspondence with the tutor or by telephone, in email courses it can be by typed interaction or by telephone. In mobile learning it can be by using the mobile phone or by SMS or by email.

The answers to this question reflect that the communication with the tutor was in the form of preparatory meetings in which the system and procedures of mobile learning were explained, and then communication was by either email, phone conversations (fixed line) or by formal meetings. The functionality for using the mobile phone or by SMS or by email will be added in later course developments.

Here are the student replies:

Communication with and feedback from the tutor in this course was easy

22%	*Strongly agree*
55%	*Agree*
11%	*Uncertain*
11%	*Disagree*
0%	*Strongly disagree*

Another important feature of the design of a didactic environment for mobile learning is the ability to provide communication to and from the other students studying the course. The large percentage of students who replied 'uncertain' to this question reflects the fact that this functionality was not available in this course but will be addressed in subsequent courses:

Mobile learning is convenient for communication with other course students

0%	*Strongly agree*
33%	*Agree*
55%	*Uncertain*
11%	*Disagree*
0%	*Strongly disagree*

Technical feasibility

To evaluate any educational innovation one needs to assess its suitability under four headings:

- Student userfriendliness
- Didactic efficiency
- Technical feasibility
- Cost effectiveness.

Technical feasibility is particularly important for mobile learning because many doubt students' ability to read course content from a mobile phone screen, many fear the slow processing and limited storage capacities of phones today. Students were therefore asked how easy it was to navigate through the material in the course. This question queried the design of the course materials and the student's ability to navigate through the course and to navigate from module to module of the course, the student's ability to access the definitions and frequently asked questions section of the course and the student's ability to undertake the questions in the course and to receive the feedback from the system.

Participants were asked:

Navigation through the mobile learning course was easy

11%	*Strongly agree*
55%	*Agree*
11%	*Uncertain*
22%	*Disagree*
0%	*Strongly disagree*

Furthermore many doubt the ability of mobile phones to provide graphics, illustrations, moving images and simulations for course materials. Years of experience with CD-Rom based materials and elearning materials have led trainers and students to expect the use of illustrative materials in elearning courses and it is clear that they might expect their provision in mobile learning too.

Participants were therefore asked:

For mobile learning to be effective it is necessary to use graphics and illustrations

33%	*Strongly agree*
33%	*Agree*
11%	*Uncertain*
22%	*Disagree*
0%	*Strongly disagree*

Questioning and feedback is an integral part of any educational experience. Student assessment can be formative assessment, in which students are questioned and given feedback as a part of their learning experience, or summative assessment, in which students are examined and their results are graded for certification at the end of a course.

In distance learning assessment is of three kinds:

- Self-assessment questions (SAQs), which were provided for the students to check and evaluate their own progress in a course
- Tutor-marked assignments (TMAs), which were submitted by the students to their tutor at regular intervals during the course for correction, commentary and feedback
- Computer-marked assignments (CMAs), which were submitted by the students to their institution's computer at fixed intervals for correction, commentary and grading.

In elearning questioning frequently takes the form of quizzes or multiple-choice questions or other forms of machine-marked assessment.

The provision of adequate questioning and assessment structures is one of the major challenges in mobile learning.

Participants were asked:

Evaluation and questioning in the mobile learning course was effective

0%	*Strongly agree*
66%	*Agree*
22%	*Uncertain*
11%	*Disagree*
0%	*Strongly disagree*

Cost effectiveness

One of the major factors in the development of mobile learning is that it increases access to training. Unlike distance training in which the trainee is located at home or at work at a distance from the institution, in mobile learning the trainee has the facility for being mobile at a distance from the institution. Unlike eLearning in which the trainee is situated in front of a wired computer, in mobile learning the trainee has the benefits of wirelessness.

Participants were therefore asked:

Mobile learning increases access to education and training

11%	*Strongly agree*
88%	*Agree*
0%	*Uncertain*
0%	*Disagree*
0%	*Strongly disagree*

For mobile learning to be a success it has to be cost effective both for the institution providing the course and for the students enrolled in it. Careful analysis needs to be undertaken on the cost of downloading a course to a mobile phone, studying it on a mobile phone, the cost of doing and submitting assignments on a mobile phone, the cost of communication with the institution, the tutor and other students studying the course via a mobile phone.

Participants were asked:

The cost of downloading the mobile course materials was acceptable

0%	*Strongly agree*
11%	*Agree*
88%	*Uncertain*
0%	*Disagree*
0%	*Strongly disagree*

The high number of 'uncertain' responses is due to the fact that the participants were downloading the course free of charge locally from the server.

The cost of communicating in the mobile learning course with the tutor and other students was acceptable.

0%	*Strongly agree*
11%	*Agree*
88%	*Uncertain*
0%	*Disagree*
0%	*Strongly disagree*

Again the high number of 'uncertain' responses is due to the fact that the participants were downloading the course free of charge locally from the server.

Comments

Participants were also invited to comment on the mobile learning course, or on equipment functionality and user-friendliness. Here is a selection of replies:

Mobile learning is great for that 30min DART ride, otherwise I think people would not be too quick to use it. It's good to give yourself a quick test but if you want to learn something new, it might prove difficult with a small screen.

I felt that reading large amounts of text on a small screen wasn't very user friendly. It would be more efficient just to use bullet points or diagrams - people would not be using this method of learning to learn from scratch. I think it would be more widely used as a means of refreshing one's mind before an exam/interview etc. Therefore long pieces of text are unnecessary.

DART is the Dublin Area Rapid Transit which would correspond to an underground railway in other cities. Both replies query the suitability of mobile learning for genuine courses of study but accept it for short summaries and revisions.

I thought the course was a great idea, and I am glad for having taken part in it. It has greatly increased both my knowledge and interest in WAP technology.

I thought the course was brilliant!

These replies are more positive and give the prospect of successful development of mobile learning for mobile telephones.

Links could have been a bit easier to follow, i.e. a more linear approach may have been better with numbering of each module and sub-module.

The importance of numbering each module and sub-module for ease of navigation in mobile learning is a valid suggestion.

Really enjoyed the WAP overview course. It was a good first step into the world of WAP technology and m-learning. I think that m-learning is a really interesting concept.

Another very positive comment supporting the implementation of mobile learning on mobile telephones.

I used the R320,T39 and R520 to do the course. It was much easier to read through on the R320 especially compared to the T39. I think if the course was short enough and something you wanted to learn about then doing it through your mobile would be effective

It was easy enough to navigate around the course especially using the R320.

Important suggestions that mobile learning can be effective if the course is short enough, if the student is required to learn it and receives reward for successful study.

Student use in Ireland 2

Mobile learning in action

This is a report on the use of mobile telephones in training in Ireland.

During the year 2002 more than 20 people were enrolled in the Ericsson *From 2G to 3G* course which had been developed for use on mobile telephones. All completed the course and filled in the international *Questionnaire on mobile learning* which is being used also in Norway, Germany and Italy.

Most of the participants used the Ericsson R380 smartphone, with a larger screen which opens out horizontally. Others used the Ericsson R520 WAP phone, or the Ericsson R320 WAP phone, which is an earlier version of it. One participant used a Noika 7110.

Personal background

Participants were managers (33%) or technical personnel (38%) or teachers/trainers (33%). I gave the employment status as 'Student' and there were no unemployed. There was a wide age range of participants: 10% stated that they were under 24 years of age, 38% between 25 and 29, 33% 30 to 40 and 15% were over 40. 70% were male and 30% female.

26% had had one to three years of post-secondary education and 69% had had four or more years of post-secondary education. This left 11% with only high school matriculation.

All owned mobile phones, but only one owned a PDA (personal digital assistant) as well.

Student userfriendliness

Participants were asked if it was easy to use the equipment in this mobile learning course. These were the replies:

It was easy to use the equipment in this mobile learning course

19%	*Strongly agree*
71%	*Agree*
5%	*Uncertain*
5%	*Disagree*
0%	*Strongly disagree*

This is a satisfactory response rate with only 10% uncertain or in disagreement. It shows that competence in the use of mobile telephony equipment can be assumed as a given in mobile training scenarios.

The next question asked if the mobile learning experience was fun. This is a challenging question for a new and experimental area of training as it queries whether the course developers were able to create an attractive learning environment for the course participants and whether the participants found the new learning experience attractive. The answers were:

This mobile learning experience was fun

10%	*Strongly agree*
48%	*Agree*
19%	*Uncertain*
24%	*Disagree*
0%	*Strongly disagree*

In spite of the 24% who disagree, the replies can be regarded as satisfactory and are superior to the replies of the students in the first trial.

Another challenging question followed, asking whether the participants would enrol in another mobile learning course. It is one thing to study a new and experimental course, it is quite different once the course has been studied and the student knows the didactic environment and the challenges of the course structure. The replies were:

According to my experience I would take another mobile learning course if relevant to my learning needs

14%	*Strongly agree*
62%	*Agree*
14%	*Uncertain*
5%	*Disagree*
5%	*Strongly disagree*

Again the response of 76% in agreement with only 10% disagreeing is a satisfactory one and again the statistics are superior to those of the first trial as presented in the previous report.

Another tricky and challenging question followed. This asked if the participant would recommend mobile learning as a mode of study to friends or colleagues. To recommend a new and experimental mode of study to colleagues and others requires a definite level of commitment to the mode of study. The answers were:

I would recommend mobile learning as a method of study to others

10%	*Strongly agree*
66%	*Agree*

14%	*Uncertain*
5%	*Disagree*
5%	*Strongly disagree*

Here the answers are again favourable with 76% in agreement and 10% disagreeing.

One of the values of mobile learning is that it restores the 'study at any time, at any place' characteristic of distance learning. This was attenuated by e-Learning's placing the student in front of a powerful wired computer for the period of training. Participants were therefore asked whether they studied the course at home or at the office/work station, or while travelling. 86% replied 'at work', 10% 'at home' and 5% 'while travelling'..

Didactic efficiency

Mobile learning is seen as a development of e-learning and it was important to learn if participants regarded it as increasing the quality of e-learning. Participants were asked:

Mobile learning increases the quality of e-learning

0%	*Strongly agree*
62%	*Agree*
29%	*Uncertain*
10%	*Disagree*
0%	*Strongly disagree*

Here the replies are less favourable than in the previous trial, with 29% being uncertain and 105 in disagreement.

If mobile learning is to be accepted as a valid form of training provision, it is important that learning objectives can be met by mobile learning courses. Participants were asked:

Course learning objectives can be met by mobile learning

10%	*Strongly agree*
66%	*Agree*
14%	*Uncertain*
10%	*Disagree*
0%	*Strongly disagree*

Only 10% of participants disagree and there are 76% who agree that course learning objectives can be met by mobile learning.

Among the difficulties to be met with mobile learning are questions related to the provision of course content. There are questions with the volume of content that can be provided in mlearning; with the downloading of content from the server; with the display of content on mobile phone screens: the small standard screen of the WAP R520 phone and the somewhat larger rectangular and horizontal screen of the smartphone R380. Participants were asked how easy was it to download course content to a mobile phone:

Downloading course content was easy

5%	*Strongly agree*
48%	*Agree*
29%	*Uncertain*
14%	*Disagree*
0%	*Strongly disagree*

The replies are mixed and indicate that there were some difficulties in downloading the material. This could cause frustration but also provided real network experience of the use of mobile learning.

An important feature of the design of a didactic environment for mobile learning is the ability to provide communication to and from the tutor and the organisation providing the course. This is essential for feedback on student progress and for the solution of study and technical problems. In distance learning courses this is provided by correspondence with the tutor or by telephone, in email courses it can be by typed interaction or by telephone. In mobile learning it can be by using the mobile phone or by SMS or by email.

Here are the student replies:

Communication with and feedback from the tutor in this course was easy

0%	*Strongly agree*
20%	*Agree*
60%	*Uncertain*
20%	*Disagree*
0%	*Strongly disagree*

The uncertainty in the replies indicates that this was a functionality of the course that was not availed of by the participants.

Another important feature of the design of a didactic environment for mobile learning is the ability to provide communication to and from the other students studying the course. The large percentage of students who replied 'uncertain' or 'disagree' to this question reflects the fact that this functionality was not used by them in this course but will be addressed in subsequent courses:

Mobile learning is convenient for communication with other course students

5%	*Strongly agree*
5%	*Agree*
55%	*Uncertain*
35%	*Disagree*

0%	*Strongly disagree*

Technical feasibility

To evaluate any educational innovation one needs to assess its suitability under four headings:

- Student userfriendliness
- Didactic efficiency
- Technical feasibility
- Cost effectiveness.

Technical feasibility is particularly important for mobile learning because many doubt students' ability to read course content from a mobile phone screen, many fear the slow processing and limited storage capacities of phones today. Students were therefore asked how easy it was to navigate through the material in the course. This question queried the design of the course materials and the student's ability to navigate through the course and to navigate from module to module of the course.

Participants were asked:

Navigation through the mobile learning course was easy

14%	*Strongly agree*
33%	*Agree*
24%	*Uncertain*
29%	*Disagree*
0%	*Strongly disagree*

The responses to this question are less favourable than in the previous trial.

Furthermore many doubt the ability of mobile phones to provide graphics, illustrations, moving images and simulations for course materials. Years of experience with CD-Rom based materials and elearning materials have led trainers and students to expect the use of illustrative materials in elearning courses and it is clear that they might expect their provision in mobile learning too.

Participants were therefore asked:

For mobile learning to be effective it is necessary to use graphics and illustrations

29%	*Strongly agree*
71%	*Agree*
0%	*Uncertain*
0%	*Disagree*
0%	*Strongly disagree*

The participants are in agreement that the inclusion of graphics and illustrations are essential for the success of mobile learning.

Questioning and feedback is an integral part of any educational experience. Student assessment can be formative assessment, in which students are questioned and given feedback as a part of their learning experience, or summative assessment, in which students are examined and their results are graded for certification at the end of a course.

In distance learning assessment is of three kinds:

- Self-assessment questions (SAQs), which were provided for the students to check and evaluate their own progress in a course
- Tutor-marked assignments (TMAs), which were submitted by the students to their tutor at regular intervals during the course for correction, commentary and feedback
- Computer-marked assignments (CMAs), which were submitted by the students to their institution's computer at fixed intervals for correction, commentary and grading.

In e-learning questioning frequently takes the form of quizzes or multiple-choice questions or other forms of machine-marked assessment.

The provision of adequate questioning and assessment structures is one of the major challenges in mobile learning.

Participants were asked:

Evaluation and questioning in the mobile learning course was effective

5%	*Strongly agree*
20%	*Agree*
40%	*Uncertain*
35%	*Disagree*
0%	*Strongly disagree*

Cost effectiveness

One of the major factors in the development of mobile learning is that it increases access to training. Unlike distance training in which the trainee is located at home or at work at a distance from the institution, in mobile learning the trainee has the facility for being mobile at a distance from the institution. Unlike eLearning in which the trainee is situated in front of a wired computer, in mobile learning the trainee has the benefits of wirelessness.

Participants were therefore asked:

Mobile learning increases access to education and training

14%	*Strongly agree*

68%	*Agree*
5%	*Uncertain*
9%	*Disagree*
5%	*Strongly disagree*

For mobile learning to be a success it has to be cost effective both for the institution providing the course and for the students enrolled in it. Careful analysis needs to be undertaken on the cost of downloading a course to a mobile phone, studying it on a mobile phone, the cost of doing and submitting assignments on a mobile phone, the cost of communication with the institution, the tutor and other students studying the course via a mobile phone.

Participants were asked:

The cost of downloading the mobile course materials was acceptable

0%	*Strongly agree*
37%	*Agree*
47%	*Uncertain*
16%	*Disagree*
0%	*Strongly disagree*

The high number of 'uncertain' and 'disagree' responses is due to the fact that the participants were downloading the course free of charge locally from the server.

The cost of communicating in the mobile learning course with the tutor and other students was acceptable.

0%	*Strongly agree*
16%	*Agree*
58%	*Uncertain*
21%	*Disagree*
5%	*Strongly disagree*

Again the high number of 'uncertain' and 'disagree' responses is due to the fact that the participants were downloading the course free of charge locally from the server.

Comments

Participants were also invited to comment on the mobile learning course, or on equipment functionality and user-friendliness. Here is a selection of replies:

Excellent concept and the course itself was good. My only negative comment was that some of the diagrams were hard to make out.

I don't think I would like to read vast amounts of course materials but it is good for summarising information and for important points/definitions etc.

I was pleasantly surprised at the use of graphics in the course. Even though they were very simple I felt that they worked well.

I didn't like the experience at all. This is my first experience with WAP m-learning and it is a bad one. I quit the course before finishing it. I really got frustrated because of the technical problems. I got numerous time-outs.

I didn't communicate with other participants or tutors, hence I have given 'disagree' to these questions.

Course was designed and put together brilliantly. Jury is out on staring at a tiny screen for too long.

Comments were also invited on equipment functionality and user-friendliness. Here is a selection of replies:

Given the display limitations compared with PCs I felt the more informal style worked well.

I got too much trouble navigating through the course – sometimes I couldn't get back to Table of Contents, because I didn't find the ToC link, sometimes I got an invalid address.

Graphics were good and user-friendly.

Student use in Norway

Norwegian Trial 1

Rekkedal (2002) carried out a detailed evaluation of the use of mobile learning on PDAs at NKI in Norway and has published the results as *Trying Out a Learning Environment for Mobile Learners.*

Rekkedal describes the evaluation thus: This paper accounts for the experiences in the first try out of an Internet based course at NKI specifically adapted to satisfy the needs of mobile learners – i.e. distance learners who for some reason need of prefer maximum flexibility of space and time in their studies. We have previously argued that we do not fully accept either the term *'e-learning'* or *'m-learning'* (Fagerberg, Rekkedal & Russell 2002, Rekkedal 2001). We shall not repeat all the arguments here; only make some few comments on the terms in question.

'Distance education' and *'distance learning'* are well-established concepts (Keegan 1996). Keegan (2000, p 18.) has also argued *"that web based education is best regarded as a subset of distance education...that the literature of the field of educational research known as distance education, is*

of value for those embarking on training on the web". The *'distance learner'* is a person who, for some reason, will not or cannot take part in educational programmes that require presence at certain times or places. It has always been one of the most important arguments for distance study that *'one may study whatever course wherever and whenever one* wishes'.

In fact, it was the introduction of the computer (and many other technologies) as well as teaching and learning methods that required presence at a certain place at certain times, which reduced the flexibility of distance learning. The introduction of mobile technologies has reintroduced flexibility and returned power to the distance learner. Thus we see the main challenges to be able to *'design learning environments for the mobile distance learner and support learners on the move'.*

Other writers have also been sceptical to accept the term, m-learning. E.g. Tommy Strandvall (2002) in a Norwegian online seminar on the pedagogy and didactics of net based distance learning suggested that as terms related to technology changes so often with new terms continuously being introduced, we could just as well agree on the term *'x-learning'.* Still, for practical reasons in this project, when we use the term m-learning, it means *'distance learning with mobile technology'.*

During 2001 the NKI project team studied International experiences concerning m-learning, analysed technological solutions and pedagogic/didactic needs based on our internal practical experiences and results from previous surveys and evaluation studies among our distance students.

The technical solution chosen was to try out the use of a Pocket PC/Personal Digital Assistant (PDA) in combination with a mobile phone for distribution of learning content and communication between tutor and students, between students and for students' communication with the learning material. When we had to make our choice in late spring 2001, we found that after analysing the functionality of different brands of PDA/Pocket PC, we chose to build our learning environment around the Compaq iPAQ 3630 and 3660. The mobile phones chosen were Ericsson T39 and Ericsson R580.

The actual work in adapting the course for mobile learners has been presented in an earlier article ((Fagerberg, Rekkedal & Russell 2002). This article presents tutor and student experiences during the first practical trials of the course, *'The tutor in distance education'* (Norwegian version). To get the full understanding of the evaluation presented here the above-mentioned article should be consulted. This pilot try out is mainly to be seen as a simulated distance learning setting. During the next phase of the project we plan to carry out a second experiment in a fully realistic setting. When this article is written (June 2002), the planning of this second trial is nearly finished. In this planning we have tried to take results and experiences from the first trial into account.

The course chosen for the first pilot evaluation, *'The tutor in distance education'* was chosen for the following reasons:

- It is a course in the pedagogy of distance teaching, and as such represents an ideal course for combining the research on media, methods and technology with the substance or content of the learning
- It is taught by internal NKI staff, also involved in the project, thus combining internal competence development with development work in the project
- The fact that same staff are involved in development and teaching in the practical try outs to be carried out opens the possibility for real field research during try out and also makes it easier to transfer the experiences and results from the experiments to further developments in the operations of the NKI Internet College
- Students taking the course are prospective online teachers in the NKI Distance Education system, their experiences as mobile learners are transferred to their teaching after completing the course

The Course

The course *'The tutor in distance education'* represents NKI's mandatory training programme for prospective NKI tutors. When it was launched in 1977 it was probably the first distance training course for distance tutors in the world. It was adapted to online teaching in 1990 and was taught on the first generation system for online distance education in NKI, the EKKO-system (see Paulsen & Rekkedal 1996, Rekkedal 1999, Rekkedal 2001). It was developed for distribution and teaching/learning on the Internet from 1996.

The course contains 3 study units and according to the Norwegian system for classifying course workload, it is equivalent to 3 ECTS Credits. The course contains mainly text, some few illustrations, and internal and external links to resources. The students may submit the three assignments individually or in groups. A discussion forum is available for asynchronous communication. The students are requested to submit a minimum of 3 contributions to the discussion forum.

The Technical Solution

The technical solution has been described and explained in detail by Fagerberg, Rekkedal and Russell (2002). The learning environment included the following aspects:

Technology:

- Pocket PC
- Mobile phone
- Portable keyboard

Learning content and communication:

- Learning content to be downloaded on the mobile device to be studied offline. Downloaded content to include all course materials:
  - Content page
  - Preface

  - Introduction
  - All study units
  - Resources (articles on the web, references to other resource materials)
- Online access to the discussion forum with the possibility of as quick as possible access for reading in the Forum and writing contributions
- E-mail for individual communication with tutor and fellow students and for submitting assignments. Assignments may be submitted as text-based e-mail or as Word or Text attachments.

In addition it was assumed that the NKI Internet students normally would have access to a desktop or laptop computer with Internet connection. This means that the equipment and technologies used when mobile are additions to the students' equipment used when studying at home or at work.

Three alternative solutions for distribution of course content were examined:

1. The AvantGo Mobile Internet service
2. Online access via mobile telephone to the entire course
3. 'Download-on-demand' version

When we decided to adopt solution 3, it was partly a result of limited time and resources available. However, our experiences during the try out have confirmed that with today's technology and pricing of software, services and communication, this solution is acceptable and probably better for both students and institution. Course content was provided in two versions *HTML* and *Microsoft Reader*.

The reason for supplying two alternatives of content is that we as part of the empirical testing are interested in examining attractiveness and user friendliness of the different solutions for the student. The student can manipulate the Microsoft Reader content by the possibility of *bookmarking, adding highlights, notes and drawings and look up words directly in the PocketPC Dictionary*. This means that the students can use the materials actively in ways that we recognise from students' use of print materials and their personal notes. The student is, in other words, able to 'make the materials his own' while studying. There is reason to believe that these functionalities may help students organising the materials cognitively and support learning and remembering.

When mobile – and using mobile technologies – it is generally satisfactory for the student (and the tutor) to have the course content available to study on the PocketPC. In addition, the following communication possibilities are necessary. When mobile, the student must be able to:

- Access the course forum to read messages
- Access the course forum to submit contributions to the discussions
- Send e-mail to fellow students, to the teacher and to administration (study advisor)
- Receive e-mail from fellow students, from the tutor and from the administration

- Submit assignments by e-mail including attachments
- Receiving assignments corrected and commented on by the tutor including attachments.

To access e-mail and discussion forums, mobile phones were used.

Screen shots of the course pages on the PC and the PDA were presented by Fagerberg, Rekkedal and Russell (2002). The course is fully presented for use on the student's PC. In addition the m-learning version had a link named *'Pocket PC'*, which links to a page containing all necessary information for downloading the content in the two versions, HTML format and Microsoft Reader format.

At the present stage and with present technological limitations the NKI project team decided that we had found an acceptable solution for presentation of course content and facilities for studying the learning materials, for solving assignments and submission of assignments to the tutor. Sending and receiving e-mails also functioned satisfactory.

During the empirical try out we wished to explore whether our solutions actually functioned and were accepted in practice.

The 'Students'

'Students' is written in inverted commas, as the pilot study of mobile learning in the NKI sub-project took place in a simulated distance learning setting with mobile technology, and the participation took place with evaluation of the m-learning system and not real learning of course content as the main goal of the activity. It should also be noted that all the 'students' had specific interest in technology for distance teaching and learning from different perspectives.

The educational background of the 9 participating students varied from two years college/university education up to Ph. D. in education, age varied from 24 to 56. One was a graduate student from the University of Oslo planning to write a thesis on mobile learning, one was a third year student of the Norwegian School of Information Technology working part time in NKI Distance Education as programmer, two participants were employed in the central NKI IT department as manager and network coordinator, one participant is employed as academic staff in information technology, the other 4 are working with the development of Internet based education at NKI.

These 'students' are generally well qualified in information technology, some also in pedagogy; and they have all specific interests connected to the development of systems, design and methods of distance teaching and learning. They are not representative of the population of distance and Internet students at NKI. However, their attention to the practice of distance education may make them well qualified for the assessment of user friendliness, didactic efficiency, technical feasibility and cost effectiveness of the environment created for m-learning in the pilot study. Their involvement in this field-testing also puts them in a good position for further development of m-learning from their individual perspective.

Evaluation Methods and Procedures

All the students and the tutor in the trial were equipped with a Compaq iPaq PDA (3650 and 3660 with 32 and 64 mb memory) and were expected to use the PDA for ordinary office work including the main programmes such as e-mail, tasks, calendar, contacts and file synchronization before the pilot m-learning trial was carried out. Three Ericsson mobile phones were purchased (T39 and R520). Some of the students had their own mobile phone. The purchased telephones were used by the tutor and 'students' by turns when needed. Two of the students also tried successfully to use a wireless LAN card with their PDA at home and at the office for receiving and sending e-mails.

The course was made available on the server for downloading and synchronization to the mobile equipment 7th January 2002, and the final data collection was finished 4 months later 30th of April.

We decided to evaluate the m-learning environment primarily by a qualitative process related field research model applying the technology to be tested. Thus, the tutor used the course forum for testing many-to-many communication by giving questions to the students related to course evaluation rather than course content. E-mails were exchanged between students and the tutor and to some extent between 'students'.

The students were required to submit assignments also related to m-learning evaluation and experiences, and the tutor commented on assignments as ordinary assignments via the PDA and mobile phone, both from Norway (also on travel) and when travelling abroad (Germany). The first response to the process related evaluation was submitted to the course forum 8th January and the last 30th of April. The evaluation questions and answers were distributed as contributions to the Forum, which means that all entries are sent as e-mail to the participants and that they also are archived and can be read on the course pages on the PC or on the PDA when connected to the Internet. This means that all the participants had access to other participants' evaluation responses during the trial.

When the trial was finished, a quantitative questionnaire for summative student course evaluation was distributed 23rd April with 1st May as the final date for response. It is this author's view that a quantitative evaluation instrument gives little meaning in a study of experiences and attitudes of 9 subjects. However, we agreed to include a quantitative element, as there are evaluations taking place in different settings and countries, with different courses, content and technology but with similar questions. There might be some advantages in combining and comparing these data for presenting a total picture of the overall project.

Results

The evaluation process

The collection of information about the students' experiences and attitudes was carried out during January till end of April 2002. The tutor conducted the evaluation process through questions put to the students in the discussion Forum, via e-mail. The procedure required the students to answer using e-mail, contribute to the Forum and through submitting responses as assignment answers in the course. During the trial the participants used both PC's connected to the Internet via LAN at work, via modems, ISDN or broadband at home and their PDAs communicating via mobile phone, synchronization and wireless LAN. All participants were required to contribute to the Forum and send e-mail via mobile technology. For evaluation purposes most reading took place on the PDA.

One of the students suggested that questions and answers were given in English to make reporting to the project more efficient. This was generally accepted with the exception of two participants who preferred to give their answers in Norwegian.

Downloading and synchronizing course materials to the PDA

3 participants answered that they tried to download the materials via telephone line and modem from home. 2 of these stated that they had technical difficulties and ended up in downloading via the office network. The third participant downloaded without problems via his home telephone line and modem and gave *24 minutes for downloading the HTML version and 1 minute and 45 seconds for downloading the e-book version.*

The tutor and 1 student downloaded at home via ISDN connection. 1 student reported that the e-book version was downloading in the office, and the *HTML version at home via modem in 18 minutes.* This took in both cases *12 minutes for the HTML version* and approximately *40 seconds for the e-book version.* 1 of the participants reported that he had downloaded the *HTML version at the office in 6 seconds (and spent in total 10 minutes for the whole process of downloading to the PC and synchronizing with the PDA (synchronizing taking most of the time).* This student also reported that he had downloaded *the e-book version on his laptop PC via infrared connection to Ericsson R580 mobile phone in "a little more than 4 minutes, being online for 6 minutes and 37 seconds*". The others, who downloaded via office LAN reported generally from 6 seconds to a little more than one minute for downloading the HTML version and 1-2 (max=6) seconds for the e-book version.

The e-book version contained only the basic course materials (296 kb), while the HTML version in addition included a large collection of resource materials, mainly research articles (5097 kb).

Problems: Very few problems were reported, except the two who mentioned difficulties in downloading via modem. The third student, who downloaded via modem at home reported: "I had no difficulties using Internet Explorer but Netscape 4.76 would open the file content directly in the browser, so I got one long page with meaningless characters. This problem should be looked further into"

In fact, the answers indicate that all participants (tutor and students) would support this statement from one of the respondents: "The whole process was easier than I expected, and I did not experience any real problems. The most time consuming part was actually the synchronization between the laptop and the PDA."

Conclusion

The participants in the trial used different ways of downloading the materials: Modem, ISDN, broadband home connection, office LAN and mobile telephone. All solutions were acceptable in time and costs. Very few problems in downloading and synchronizing to the PDA were reported, except 2 students who had technical problems in downloading via modem. (Reasons for these difficulties are not known.)

The participants' study situation

The student, who also was studying at the University of Oslo, comments that in his University studies he mainly reads textbooks, and does not use his laptop when travelling. He further comments that his experiences with the PDA has made him reflect on the advantages of using a the PDA combined with mobile telephone for communicating, "... I clearly see the advantages of study being connected with PDA and mobile phone, and also study offline with materials downloaded and synchronized to the PDA." He further comments that at home he studies with a desktop and ISDN line and has chosen to receive all messages in the trial course Forum as e-mail. Since his software was not fully compatible with the PDA software, he decided to upgrade the computer and software.

In general, both the tutor and the students in the trial work from home, from the office and on travel. This question was answered only a few days after the study had started. It is clear that the participants already had discovered positive and negative sides of the functionality, such as increased flexibility in using lightweight equipment, but also need for extra keyboard, that the screen was small for some content such as illustrations etc.

Reading and studying on the PDA

To assess the quality and acceptability of the downloaded materials for study, we delivered two versions, the complete course in HTML to be read in the PDA browser, and the main course in Microsoft Reader e-book format.

The students are only partly satisfied with reading subject matter in HTML format on the PDA. Generally, they accept reading small quantities of texts and they accept that it is acceptable on travel and when commuting, when they look at benefits (lightweight equipment and large amounts of materials available) relative to the drawbacks or difficulties (getting an overview of the materials to study, small screen etc.) At this time the students had already acquainted themselves with the Microsoft Reader and compare the two solutions. It seems that the students generally prefer the e-book solution, the object of the next evaluation question.

Many mention the problem of note taking. It is clear that a keyboard is considered to be necessary. The screen keyboard is not acceptable for writing more than a few short words. The students do not appreciate making notes on paper for later copying to the PDA or PC. The students also complain that the illustrations are unacceptable. (In this first trial version no specific measures were taken to solve this problem. It was considered that as the students had all the materials also on their PCs, the illustrations in the PDA text version only indicated and reminded of the original graphics. This should be solved in further courses to be developed for NKI m-learning).

Reading and note taking with Microsoft e-book reader

As mentioned the answers on the HTML solution demonstrated that the participants already had found that the e-book solution in many ways was better, mainly because of possibilities of active note taking, highlighting and other functionalities.

The students are generally quite positive, but they agree that they would not be happy with an m-course requiring that all texts and learning materials were presented on the PDA. As with other Internet students in NKI, they seem to prefer reading longer texts on paper. One of the students replied:

> *I found using the PDA as a study tool very convenient. This time I actually was in laid-back modus, using the PDA while sitting/laying on the couch. While reading, I tried to figure out what kind of notes would be most effective for my use. I highlighted the text regarding elements I wanted to save for further use in later repetition. I also tried to use the note function, though it took me a couple of minutes to master the 'back' button on the PDA to shift from Microsoft Reader to Notes. After reading the text, I went to the index containing my highlighted elements.*

It also seems that there are individual differences between the students concerning preference for writing 'electronically' or on paper:

Conclusion

It was quite clear that the students preferred the e-book version to the HTML version. They found some positive aspects of the text manipulation functions of the e-book format, but differed in their views of how useful these functions were.

They agree that reading long texts on the PDA is not highly appreciated (in many ways these viewpoints do not differ much from student's viewpoints on reading long texts on large computer screens).

Contribution to Forum via PDA and mobile phone

While the trial course presented the study materials as zipfiles to be downloaded and studied offline, sending and receiving messages and reading Forum archive entries and contributing to the Forum had to take place online.

Very few problems were detected. Different brands and types of mobile telephones were used, Nokia and Ericsson. The PDAs were set up according to specifications with few if any problems. Those who used the phones abroad, had some difficulties. It took some time before we understood how to set up for international calls, and when in Germany it was experienced that some networks did not seem to accept our Norwegian data subscription (possible explanation)(?). When the tutor was at Spitsbergen, it proved impossible to connect to the server in Norway. The network provider explained this with problems concerning direct connection to the server via satellite communication.

Conclusion

Setting up the PDA for mobile communication was easily done with the correct information at hand. Setting up for international calls proved somewhat more difficult. Communication online with the Forum functioned well and could be organised within a few minutes connection time. It is important that the Forum is linked directly, so that the page does not open as a frame on the PDA screen, as the text field then becomes very, very small.

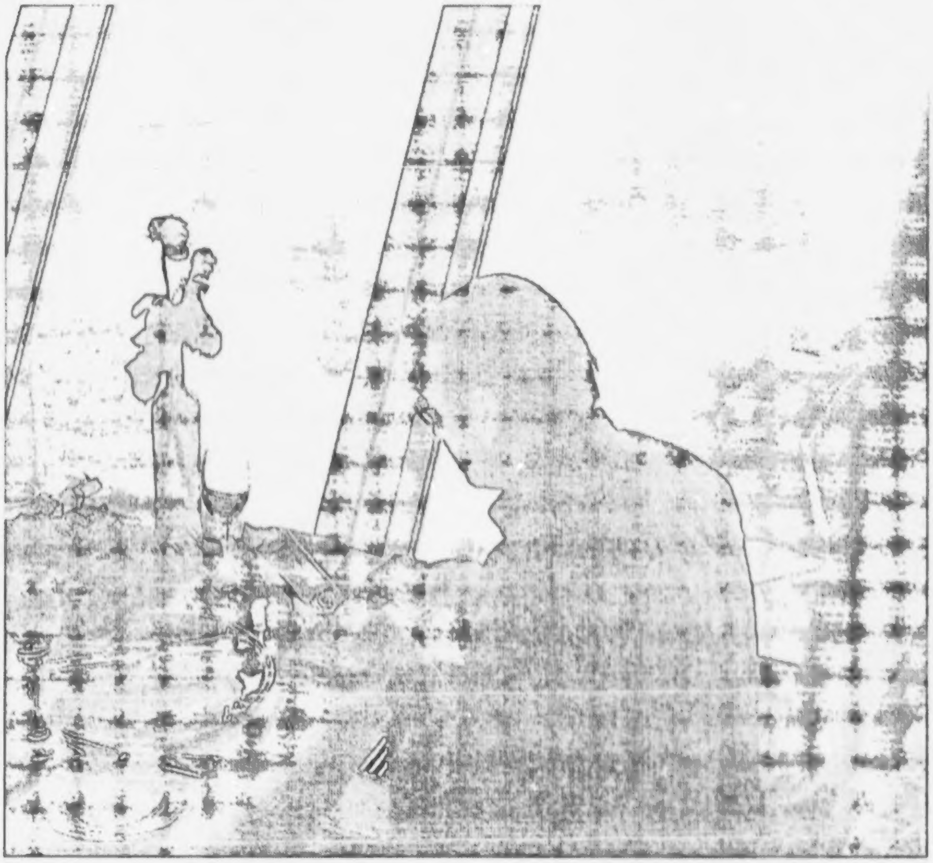
Assignments for submission via mobile technology

E-mail communication including submitting assignments for the tutor to comment on and return to the student is an important aspect in most distance education systems. In this trial many e-mails were exchanged between the students and the tutor. Only one assignment for submission was mandatory in the trial. Instead of answering one of the standard assignments of the course, the tutor asked the students to submit answers to on assignment for submission with 3 questions on *'mobile learning'*. The students were supposed to answer the questions and submit the answers using their PDA and mobile phone. The assignment was to be answered in the format of text in an ordinary e-mail and the full answer should also be attached as a word document.

The solution chosen resulted that *the assignment for submission in this case functioned both as the subject of evaluation and a means for evaluation.*

5 students did the task and submitted their answers to the evaluator within the date mentioned. There were no real difficulties in this communication. It

should be mentioned that the answers were received just before the tutor/evaluator embarked on the travel to the project meeting in Hagen 15th March 2002. 4 of the 5 assignments were commented on using the portable keyboard while flying from Oslo to Copenhagen and Copenhagen to Düsseldorf. The commented assignments were returned to the students via mobile phone while on the train between Düsseldorf and Hagen. When connected on the train, the 5th assignment was received. This was returned with comments from the hotel in Hagen.



The tutor/evaluator writing and sending e-mails to the students from Düsseldorf 'Himmelturm'.

Conclusions concerning e-mail communication for assignments with attachments

The conclusion from the above e-mail is that communicating through the mobile technology and networks functions generally without problems – also abroad. There is some lack of compatibility between PDA Microsoft software and PC software. E.g. word documents received from students and synchronized to the PDA and returned with comments via the PDA and mobile phone cannot be read by the Microsoft software on the PC, i.e. 'Pocket Word' are not readable for students with ordinary Microsoft Word on their PC. However, when the documents are both received and returned on the PDA, there does not seem to be any problems.

Otherwise – communication is efficient at acceptable speed and costs. We had from time to time some difficulties in receiving and transmitting e-mails. Problems seem mainly to be that when connection to the mobile network was weak, the transmission failed. But we managed to transmit all e-mail messages before leaving Germany.

Final evaluation

In your view, how can m-learning as designed in this experiment increase the quality of e-learning?

The students generally stressed the aspect emphasised by NKI that distance education should satisfy the adult learner's need for flexibility. This point is mentioned by all and it is referred to both the continuous availability of learning materials and the possibility of communication anytime and anywhere.

With services, such as GPRS, students could be continuously online and send and receive messages. Whether this is a functionality that would be acceptable in practice remains to be seen. For tutors it is obviously a heavy strain if they were expected to be available continuously on their mobile equipment (see for instance Paulsen 1998) on teachers' perception of their workload in online education

Which additional problems may the student experience (When learning with mobile technology)?

It should be noted that in this experiment all participants had to get acquainted with the technology to take part in the trial study. In a real situation we must assume that the students participate in m-learning courses partly because they already have the technology available and wish to use it for extending their access to materials and communication in the learning situation. Then problems related to the technology itself would probably be minimal.

What increased benefits may the student experience?

Again, it is the increased flexibility that is mentioned, both concerning the accessibility of learning materials (content) and resource persons (fellow students and the tutor).

General comments

It was commented by some that at present there are lacking functionalities in the technology, e.g. one missed that bluetooth technology was not installed in the PDAs used. Bluetooth would make the equipment easier to use. Faster and cheaper communication is also necessary for m-learning to be satisfactory. As it is now, one is more concerned with technology related problems that the methodology of teaching and learning in m-learning. The students also commented (as was our assumption of the design for m-learning) that the availability of an ordinary PC is necessary for being satisfied with m-learning. Again it was commented by most that portable keyboard is necessary and that the screen is not suitable for reading longer texts, and there is no doubt that the screen is not acceptable for the time being for browsing web pages that are not designed to be read on an PDA.

The questionnaire answers

As mentioned, tables of questionnaire answers are presented mainly for a possible future combination with answers from students in the other pilot trials of the project.

Table 1. Questionnaire section 1. Personal background

	n	%	n	%	n	%	n	%	n	%	N
1. Occupation	Manager		Technical		Teacher/trainer		Student				
	1	11	5	56	2	22	1	11			9
2. Age grouping	>24 years		25-29 years		30-40 years		41-50 years		> 50 years		
	1	11	-	-	4	44	2	22	2	22	9
3. Gender	Male		Female								
	9	100	-	-							9
4. Level of education	High school		1-3 years p.s		4 ore more p.s.						
	1	11-	1	11	7	78					9
5.Mobile device ownership	Mobile phone		PDA		Both *						
	-	-	-	-	9	100					9
10. Where did you study?**	At home		At work		Both home/w		On travel***				
	2	22	-	-	2	22	5	56			9

**All the participants had got their PDA in connection with the project.*

*** In the questionnaire this question was put under 'user friendliness*

**** No one ticked only "when travelling", 2 ticked all three alternatives, 2 ticked "at home and when travelling and 1 ticked at work and when travelling*

All the participants of the pilot trial, except one (student in education at the University of Oslo) had connection with NKI research and IT/educational development. This background made them both open for and critical to new technology and present 'state of the art'. All were men in age from 24 to 56 years. All had a mobile phone before the trial started, experience in using PDA ranged from a 1 month up to 1 year. 5 of the respondents (plus the tutor/evaluator not included in the questionnaire) used the technology on travel during the trial.

Table 2. Questionnaire section 2. Student user friendliness

	Strongly Agree		Agree		Uncertain		Disagree		Strongly disagree		N
	n	%	n	%	n	%	n	%	n	%	
Equipment easy to use	-	-	7	78	1	11	1	11	-	-	9
The mobile learning exp. was fun	3	33	3	33	2	22	1	11	-	-	9
I could take another m-learning course	2	22	3	33	3	33	1	11	-	-	9
I would recommend m-learning	1	11	3	33	4	44	1	11	-	-	9

One of the participants is consistently on the negative side. He was the oldest person and naturally also one of the least active participants during study. He also clearly commented that he preferred pencil and paper both for note taking and reading. It also seems clear that the youngest participants are the most positive ones on all questions, the two most positive on all aspects were the two students who also are real students in other settings during the trial.

Table 3. Questionnaire section 3. Didactic efficiency

	Strongly Agree		Agree		Uncertain		Disagree		Strongly disagree		N
	n	%	n	%	n	%	n	%	n	%	
11. M-learning increases quality	1	11	1	11	5	56	2	22	-	-	9
12. Learning obj. can be met by m-l.	-	-	3	33	4	44	2	22	-	-	9
13. Downl. course content was easy	-	-	4	44	4	44	1	11	-	-	9
14. Communication w. tutor was easy	-	-	7	78	1	11	1	11	-	-	9
15. M-l conven. for comm. w. students	-	-	4	44	3	33	1	11	1	11	9

Concerning quality, the students are uncertain whether m-learning increases quality of e-learning. This is because the technology at present islacking in functionality relative to online learning based on ordinary PCs and Internet connection, difficulties in reading on the small PDA screen and the need for a keyboard for writing. They do not agree whether (all?) objectives can be met by m-learning. It should be noted that they found communication with the tutor easy, but are more reserved whether m-learning is convenient for communication with fellow students.

Table 4. Questionnaire Section 4. Technical feasibility

	Strongly Agree		Agree		Uncertain		Disagree		Strongly disagree		N
	n	%	n	%	n	%	n	%	n	%	
16. Navigation was easy	1	11	7	78	-	-	1	11	-	-	9
17. Graphics and illustr. necessary	2	22	3	33	2	22	2	22	-	-	9
18. Eval. and quest. was effective	-	-	5	56	3	33	1	11	-	-	9

Most of the students found navigation easy. They do not agree whether graphics and illustrations are necessary. A majority agreed that evaluation and questioning was effective.

Table 5. Questionnaire Section 5. Cost effectiveness

	Strongly Agree		Agree		Uncertain		Disagree		Strongly disagree		N
	n	%	n	%	n	%	n	%	n	%	
19. M-learning increases access	2	22	5	56	1	11	1	11	-	-	9
20. Cost of downl. was acceptable	3	33	4	44	1	11	1	11	-	-	9
21. Cost of comm. was acceptable	-	-	4	44	1	11	2	22	1	11	9

Most of the participants agree that m-learning increases access to learning. On the negative side is, of course, that access to technology is lacking at present. The majority found that cost for downloading the course materials was acceptable, but it is not surprising that some find the cost for communication unacceptable (at present).

Discussion and Conclusion

The course *'The tutor in distance education'* was adapted for m-learning, assuming thatboth tutor and students would use a standard state of the art (2001/2002) PDA and mobile phone for study of learning materials and for communication one-to-one and many-to-many *when on the move*. The assumption was also that the m-learning should be part of a distance education setting based on the Internet and WWW as the main medium for learning, and also that participants should apply ordinary PCs (desktop or laptop) when studying at home or at work.

The participants in the trial were equipped with a Compaq iPaq PDA 3630 or 3660 and mobile phones. Some of the students had to borrowmobile phones and keyboard when needed. All participants had had the possibility of getting acquainted with the technology for other office and study applications before the trial started.

As the students were recruited for the course for assessment of m-learning problems and challenges, more that actually for studying the course, they are seen as pilot trial students rather than real students. Still, we see that the results as valid for decisions about future developments of solutions for mobile distance students in the NKI distance education system.

Downloading and synchronizing learning materials

There were practically no problems experienced in downloading the materials to the PC and synchronizing with the PDA. Two students had difficulties downloading through their modems, while a third student had no difficulties. The downloading could be done at acceptable time and costs through all the different connection solutions used.

Technical solution and problems

The Compaq iPaq operating system is unstable. All participants experienced the need for soft restart at numerous occasions when the system broke down. The soft restart is quickly and easily done, but it is irritating that the technology breaks down so often. (We have later installed PocketPC 2002 on 3660 and 3870.)

All participants agreed that in order to use the PDA for effective studies and writing more than a few words, the screen keyboard is not sufficient. One needs a portable keyboard (which increases the equipment to carry, and the question arises whether a small laptop is a better solution when mobile). Presently (June 2002) we cannot get a Norwegian keyboard. However, there is software on the market (example Sunnysoft http://www.sunnysoft.cz/).

Connection to the Internet through infrared ports is acceptable when using the screen keyboard, but if using the portable keyboard to connect the ports, one has to make some improvised solutions to support the phone on the top of the PDA. With bluetooth technology connecting phone and Pocket PC is much better solved.

The PDA for studying

The participants seem to agree that it is acceptable to read from the small PDA screen. Some are enthusiastic when they look at the advantage of being able to carry course materials and read on the move and at occasional situations. This advantage seems to compensate for the difficulties reading from the screen. Some comment that they do not like reading from the small screen (in fact they dislike reading also from ordinary computer screens) more than very short texts.

It seems that the Microsoft e-book format is preferred to the HTML format. Thus, in the following trial with real students we will produce the learning materials in e-book format only.

At present, it seems that the HTML format makes it easier to provide links within the materials and organise the materials in separate files in logical order with content list with links etc.

We had had difficulties presenting illustrations in readable form on the PDA. Graphics are not easily transferred to the PDA, and in this trial we accepted that full understanding of illustrations were only possible on the PC. This problem must be solved if the technology should be acceptable for courses with more emphasis on graphical illustrations.

Note taking

The participants were asked whether the PDA was suitable for active note taking when studying. Related to the preference for reading in the e-book format, the students also found that using the functions of making notes, bookmarks, highlighting etc. One comments that he prefers taking notes on paper, and all agree that the portable keyboard is a necessary additional equipment to use the PDA actively for note taking.

Sending and receiving e-mails

Setting up Internet connection and e-mail service on the PDA was not easy, but with the purchaser's manual it functioned well. We also had some difficulties finding the correct settings for connection to the Internet from abroad, but after some trial and error we succeeded. If one normally receives many and heavy e-mails, it is important to set the mail to receive only headers and afterwards decide which e-mails to download. When the settings are correctly installed, the mail system functioned to our full satisfaction. We had no difficulties with attachments. The tutor may comment in the students' assignments using separate colours or text types. This functioned also quite well, although changing fonts is more time consuming and needs more steps than on an ordinary key board using macros.

Reading and writing online through the browser

Reading the NKI Internet college pages online through the PDA browser is generally not acceptable. The pages are not designed for browsing on the PDA. However, the only need to be online to the NKI Internet College in this pilot trial was for contributing to the course discussion Forum. Writing contributions to the Forum has to be done online by writing in the text field in the browser. The best solution is to write the text offline in Notes or Word and copy the text into the text field. This procedure could be done easily and in short time.

Conclusion

Rekkedal completes his analysis with the following conclusion:

NKI Distance Education gives main emphasis and priority to student autonomy, flexibility and freedom to choose where and when to study in designing the environment for distance learners. Our main aim in designing solutions for mobile learners is to maximize this freedom to support online learners who also are mobile when studying. This is also clear from all the participants in this pilot trial; the main advantage of m-learning is the *increased flexibility of online distance education.*

Our pilot trial with mobile technology (PDA and mobile phone) showed that the technology functioned according to our expectations. The participants were generally satisfied with the technological and didactical solutions. The participants differed somewhat in their acceptance. Some were quite enthusiastic; others were a little more reserved. The differences could partly be related to different learning styles and study preferences, such as preference for note taking on paper and/or general reluctance towards reading longer texts from (any screen).

In the NKI system it will be a challenge to design solutions for learners who are users of mobile technology and have a need to study also when on the move, and that other students, who prefer to use standard technology can do that, and that both groups may participate in the same course. This means that we have to look for solutions that are optimal for distributing content and communication in courses, independent on whether the students and tutors apply mobile technology or standard PC and Internet connection for teaching or learning.

The next trial will take place from summer 2002 with a few real students in the course *'SPICE 603 – Online Teaching and Learning'*. In the next trial course materials for PDA will be presented in e-book format, the tutor and students will use Compaq iPaq (3630, 3660, 3870) and Ericsson mobile phones T39m and R580, portable keyboards and both IR and bluetooth connection. The results from this trial will be taken into account in the design and the teaching/learning process.

Norwegian trial 2

A further trial was carried out in Norway during the summer of 2002. Rekkedal (2002) reports on this in a study with the title *Enhancing the flexibility of distance education - experiences with a learning environment for mobile distance learners.*

Rekkedal presents his findings thus:

Students' and tutor's use of technology when mobile

When mobile – and using mobile technologies – we have found that it is generally satisfactory for the student (and the tutor) to have the course content available to study on the PocketPC. In addition, the following communication possibilities are necessary. When mobile, the student must be able to:

- Access the course forum archive to read messages (if necessary) (messages on the forum is also sent to participants as e-mails)
- Access the course forum to submit contributions to the discussions
- Send e-mail to fellow students, to the teacher and to administration (study advisor)
- Receive e-mail from fellow students, from the tutor and from the administration
- Submit assignments by e-mail including attachments
- Receiving assignments corrected and commented on by the tutor including attachments.

To access e-mail and discussion forums, mobile phones were used.

The Trials

The courses

During the project period two courses have been tried out with students using mobile phone and PDA. The two courses were:

1. *The tutor in distance education (Norwegian version)*
2. *SPICE 603 Online Teaching and Learning*

The first course was tried out from January until end of April 2002. The second course was launched for mobile access at the end of June 2002. When writing this paper the second course is still running in its trial version.

The tutor in distance education

The course *'The tutor in distance education'* represents NKI's mandatory training programme for prospective NKI tutors. When it was launched in 1977 it was probably the first distance training course for distance tutors in the world. It was adapted to online teaching in 1990 and was taught on the first generation system for online distance education in NKI, the EKKO-system (see Paulsen & Rekkedal 1996, Rekkedal 1999, Rekkedal 2001). It was developed for distribution and teaching/learning on the Internet from 1996. The course contains 3 study units and according to the Norwegian system for classifying course workload, it is equivalent to 3 ECTS Credits. The course contains mainly text, some few illustrations, and internal and external links to resources. The students may submit the three assignments individually or in groups. A discussion forum is available for asynchronous communication. The students are requested to submit a minimum of 3 contributions to the discussion forum.

SPICE 603 Online Teaching and Learning

The course *"Online Teaching and Learning"* is one of 5 courses in the programme *"Specialization Programme in International Online Education"* and constitute 6 ECTS Credits. It has 5 mandatory assignments for group or individual submission.

More detailed description of experimental conditions

Trial 2

The second course was to be tried out in a real situation. Actually, one of the 'students' from the first trial tutors the second course. During the trial the course has 5 registered active students, 4 in Norway and 1 in California. 3 of the 4 Norwegian students are using mobile technology. During the experiment one of the three experimental students stayed for some weeks in Tanzania, and one has travelled and communicated from the USA and European countries. The 3 mobile learners are 1 man (age 32, bachelor in computer science) and 2 women (age 55, Pd.D in chemistry and working as web master and age 35, bachelor of education, director of studies at a research centre).

In a future real situation we assume that mobile learners have access to and experience with the necessary technology before actually applying the technology for learning. This was not really the case in this experiment, as only one of the three experiment students owned the technology and was an experienced user before embarking on the course. (He was also one of the 'students' in the first course trial, but was enrolled as an ordinary student in the second course.) The two other experimental students were equipped with the technology when starting on the course. Thus, they met some minor introductory problems of setting up the PDA for communicating with the mobile phone, which one would not expect with future experienced users of the technology. (To some extent these problems were similar to those we experienced when online learning was introduced 15 years ago.)

The technical solutions were the same in both trials, except that as we learned from the first course that course content in Microsoft Reader format was preferred before HTML-format, we only supplied Reader files for the SPICE course. During the first trial only the tutor and one student was supplied with portable keyboard. Keyboard was seen as a necessary functionality, thus during the second trial all three students and the tutor were supplied with keyboards to be used with their PDAs. During the second trial the PDAs had the 2002 operating system installed. This gave better presentation of graphics and tables.

Evaluation Methods and Procedures

All the students and the tutors in both trials were equipped with a Compaq iPaq PDA (3650, 3660 and 3870 with 32 and 64 mb memory). During the first trial the participants had made themselves acquainted with the use the PDA for ordinary office work including the main programmes such as e-mail, tasks, calendar, contacts and file synchronization before the pilot m-learning trial was carried out. In total five Ericsson mobile phones were purchased (T39 and R520). Two of the students in the first trial (and the tutor in the second trial) also tried successfully to use a wireless LAN card with their PDA at home and at the office for receiving and sending e-mails.

The first course was made available on the server for downloading and synchronization to the mobile equipment 7th January 2002, and the final data collection was finished 4 months later 30th of April. The second course was made available for mobile equipment end of June 2002. However, with one exception the students did not really start their studies before mid September.

We decided to evaluate the m-learning environment primarily by a qualitative process related to a field research model applying the technology to be tested. Thus, during the first trial the tutor (who was also the evaluator) used the course forum for testing many-to-many communication by giving questions to the students related to course evaluation rather than course content. E-mails were exchanged between students and the tutor and to some extent between 'students'. The students were required to submit assignments also related to the m-learning evaluation and experiences rather than on course content, and the tutor commented on assignments as ordinary assignments via the PDA and mobile phone, both from Norway (also on travel) and when travelling abroad (Germany). The first response to the process related evaluation was submitted to the course forum 8th January and the last 30th of April. The evaluation questions and answers were distributed as contributions to the Forum, which means that all entries are sent as e-mail to the participants and that they also are archived and can be read on the course pages on the PC or on the PDA when connected to the Internet. This means that all the participants had access to other participants' evaluation responses during the trial.

When the first trial was finished, a quantitative questionnaire for summative student course evaluation was distributed 23rd April with 1st May as the final date for response.

As mentioned, the second trial followed the same procedures, except that the situation was more realistic as students were real students studying the course. All three experimental students planned to complete the whole 30 ECTS Credit programme. Thus, the evaluation was carried out as a completely different process parallel to the teaching-learning process by this author as evaluator only, not involved in the course itself. (Regrettably, the teaching-learning process of the second course will not be finished during the process period. Thus, the evaluation is not finished at the time of this conference.)

Results

The participant's study situation

(Results from the first trial have been published in a separate article before (Rekkedal, T. 2002). http://learning.ericsson.net/leonardo/NKI2001m-learningevaluationFinal.doc

In general, both the tutor and the students in both trials worked from home, from the office and on travel. It clearly seems that the participants find that the mobile equipment functions satisfactory for reading and communicating when travelling. Connection time becomes very expensive when abroad, e.g. connection time from Tanzania was over 4 Euro per minute.

During the second trial one of the students answered:

"As I am taking this course through work, most of my studying online takes place at work. (I am given time during work hours and employer is paying for the course). My daily work consists of a lot of time in front of the computer and thus it is easy for me to study whilst being connected anyway. In periods I work out of the office - running residential courses - and in these periods I do not study during work hours at all.

At home I would study in the evening after kids bedtime (21h) as well as sometimes at weekends. Mostly I use programmes like word and Microsoft Reader at home - writing assignments.

I also would study during travel – in evenings at hotel rooms, on the plane/train as well as out in the field when collecting data for projects. I have already used the equipment/course in Tanzania, which worked well."

One of the other students in the second trial replied:

"The main part of my study will take place in my home and when travelling both abroad and in Norway. If I took the bus or train to work I would certainly have used that spare time to study.

I would also consider studying a little bit when I'm on vacation since the equipment is easy to bring with me and I have all I need of readings etc on the PDA.

Downloading and synchronizing learning content

Generally, the participants experienced few problems in downloading and synchronizing learning materials to their PDA. For the first course the files were supplied as on self-extracting zip-file and one Microsoft Reader file. Two participants during the first trial did not manage to download the content via their modems at home, reasons not found. A third student, however, had no difficulties, and spent 24 minutes downloading the extensive HTML version of the first course. It seems that most participants will easily and cheaply be able to download the learning materials. In fact, the answers indicate that all participants (tutor and students) would support this statement from one of the respondents: "The whole process was easier than I expected, and I did not experience any real problems. The most time consuming part was actually the synchronization between the laptop and the PDA."

Downloading the Microsoft Reader versions was very fast and easy in both trials.

The participants in the two trials used different ways of downloading the materials: Modem and ISDN connections, broadband home connection, office LAN and mobile telephone. All solutions were considered to be acceptable in time and costs.

Reading and studying on the PDA

As mentioned, to assess the quality and acceptability of the downloaded materials for study, in the first trial we delivered two versions, the complete course in HTML to be read in the PDA browser, and the main course in Microsoft Reader e-book format.

The students in the first trial were only partly satisfied with reading subject matter in HTML format on the PDA. Generally, they accepted reading small quantities of texts and they found it acceptable on travel and when commuting, when they look at benefits (lightweight equipment and large amounts of materials available) relative to the drawbacks or difficulties (getting an overview of the materials to study, small screen etc.) During the first trial it seemed that the students generally preferred the Microsoft Reader e-book solution. This was the reason for supplying this solution only for the second trial.

The problem of note taking was generally mentioned. During the first trial it became clear that a keyboard was considered to be necessary for efficient study. The screen keyboard was not considered acceptable for writing more than a few short words. The students did not appreciate making notes on paper for later copying to the PDA or PC. The students also complained that the illustrations were unacceptable. (No specific measures were taken to solve this problem. It was considered that as the students had all the materials also on their PCs, the illustrations in the PDA text version only indicated and reminded of the original graphics.) This should be solved in further courses to be developed for NKI m-learning. One of the 'students' in the first trial (an over 50 years old man with a masters degree in engineering) stated that he generally was reluctant reading from the screen. He preferred to print materials on paper, and, of course, reading from the PDA screen was not seen to acceptable.

It was quite clear that the students preferred the e-book version to the HTML version. They found some positive aspects of the text manipulation functions of the e-book format, but differed in their views of how useful these functions were.

They agree that reading long texts on the PDA is not highly appreciated (in many ways these viewpoints do not differ much from student's viewpoints on reading long texts on large computer screens).

Contribution to Forum via PDA and mobile phone

While both trial courses presented the study materials to be downloaded and studied offline, sending and receiving messages and reading Forum archive entries and contributing to the Forum had to take place online. We asked the students whether they had met problems setting up their PDAs for connection to the Internet via mobile phone, how they solved the activity of writing and sending to the Forum, how long they were connected and whether they met any problems during the process.

Very few problems were detected. Different brands and types of mobile telephones were used, Nokia and Ericsson. The PDAs were set up according to specifications with few if any problems. Those, who used the phones from abroad, had some difficulties. It took some time before we understood how to set up for international calls, and when in Germany it was experienced that some networks did not seem to accept our Norwegian data subscription (possible explanation)(?). When the tutor in the first trial was at Spitsbergen, it proved impossible to connect to the server in Norway. The network provider explained this with problems concerning direct connection to the server via satellite communication.

Setting up the PDA for mobile communication was easily done with the correct information at hand. Setting up for international calls proved somewhat more difficult. Communication online with the Forum functioned well and could be organised within a few minutes connection time. It is important that the Forum is linked by a 'mobile favourite' directly (preferably to the 'printer friendly' version of the page), so that the page does not open as a frame on the PDA screen, as the text field then becomes very, very small. Most participants prepared their entry offline and copied the message into the text field before sending to the Forum.

Assignment for submission via mobile technology

E-mail communication including submitting assignments for the tutor to comment on and return to the student is an important aspect in most distance education systems. In both trials many e-mails were exchanged between the students and the tutor. Also assignments were submitted via the PDA and mobile phone. During the trial for test purposes the assignments were to be answered both in the format of text in an ordinary e-mail and with the same answer attached as a word document.

There seemed to be no real difficulties in writing answers to assignments and sending receiving. It should be mentioned that during the first trial 4 answers to an assignments were received just before the tutor/evaluator embarked the plane to travel to a project meeting in Hagen 15th March 2002. These assignments were commented on using the portable keyboard while flying from Oslo to Copenhagen and Copenhagen to Düsseldorf. The commented assignments were returned to the students via mobile phone while on the train between Düsseldorf and Hagen. When connected on the train, a 5th assignment was received. This was returned with comments from the hotel in Hagen. (See assignment example with comments, Appendix 1.)

The conclusion is that communicating through the mobile technology and networks functions generally without problems at acceptable speed and costs. There is some lack of compatibility between PDA Microsoft software and PC software.

Conclusion

When completing this paper the second trial was not concluded. Thus, the conclusions relate more to the first trial than to the second. However, so far it seems that there is no large difference in opinions and experiences from the two evaluation studies.

As pointed out, NKI Distance Education gives main emphasis and priority to student autonomy, flexibility and freedom to choose where and when to study in designing the environment for distance learners. Our main aim in designing solutions for mobile learners is to maximize this freedom to support online learners who also are mobile when studying. This is also clear from all the participants in the pilot trials; the main advantage of m-learning as designed in these trials, is the *increased flexibility of online distance education*.

Our pilot trials with mobile technology (PDA and mobile phone) have demonstrated that the technology functioned according to our expectations. The participants were generally satisfied with the technological and didactical solutions. The participants differed somewhat in their acceptance. Some were quite enthusiastic; others were a little more reserved. The differences could partly be related to different learning styles and study preferences, such as preference for note taking on paper and/or general reluctance towards reading longer texts from (any) screen.

In the NKI system it will be a challenge to design solutions for learners who are users of mobile technology and wish to study also when on the move, that also allow other students to apply standard technology. The solutions must be designed in ways to allow both groups to participate in the same course. This means that we have to look for solutions that are optimal for distributing content and communication in courses, independent on whether the students and tutors apply mobile technology or standard PC and Internet connection for teaching or learning.

During our two trials and experiences with the technology over nearly two years, we have met some technical problems. E.g. this author have experienced that word documents received as attachment to e-mails and synchronized to the PDA, commented on and returned via mobile technology could not be opened by the student. (This problem seems to have been solved by Sunnysoft Interwrite (http://www.sunnysoft.cz/), which also has solved our problems concerning Norwegian characters on the portable keyboard.) Also Microsoft Pocket PC 2002 software has better functionality and stability than previous versions. We have learned that a portable keyboard is necessary to fully exploit the possibilities of the PDA for learning.

There is no doubt that NKI Distance Education faces a large challenge in further developing server side solutions and methodology that include the use of mobile technology for serving our mobile distance learners more efficiently. We really look forward to continue the developments and experiments.

CHAPTER 10 CONCLUSION

The future of learning

Mobile learning, the study of the provision of education and training from wireless devices, is situated clearly in the future of learning.

The most authoritative study of the contemporary developments in learning is *How people learn: brain, mind, experience and school* edited by Brandsford, Brown and Cocking and published in 2000 for the National Academy Press in Washington D.C. for the US Commission on Behavioral and Social Sciences and Education National Research Council.

They give the following reasons for the contemporary advances in the study of learning:

- Research from cognitive psychology has increased understanding of the nature of competent performance and the principles of knowledge organisation that underlie people's abilities to solve problems in a wide variety of areas, including mathematics, science, literature, social studies and history.
- Developmental researchers have shown that young children understand a great deal about basic principles of biology and physical causality, about number, narrative and personal intent, and that these capabilities make it possible to create innovative curricula that introduce important concepts for advanced reasoning at early ages.
- Research on learning and transfer has uncovered important principles for structuring learning experiences that enable people to use what they have learned in new settings.
- Work in social psychology, cognitive psychology, and anthropology is making clear that all learning takes place in settings that have particular sets of cultural and social norms and expectations and that these settings influence learning and transfer in powerful ways.
- Neuroscience is beginning to provide evidence for many principles of learning that have emerged from laboratory research, and it is showing how learning changes the physical structure of the brain and, with it, the functional organisation of the brain.
- Collaborative studies of the design and evaluation of learning environments, among cognitive and developmental psychologists and educators, are yielding new knowledge about the nature of learning and teaching as it takes place in a variety of settings. In addition, researchers are discovering ways to learn from the 'wisdom of practice' that comes from successful teachers who can share their expertise.
- Emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimagined even a few years ago.

The 'emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimagined even a few years ago' that are studied in this book are the wireless technologies of the mobile revolution that has seen the world wide proliferation of wireless communication devices.

The evolution of distance learning has been detailed above.

The arrival of eLearning, the award of nationally and internationally recognised university degrees, college diplomas and training certification, to students who spend much or all of their study time in front of a computer screen, can be dated to 1995 and has spread globally since.

The penetration of mobile telephony worldwide dates from the 1990s. Recent statistics show that China is the country with the most mobile phones at 170.000.000 in mid-2001, closely followed by the United States and Japan. Ericsson statistics for mid 2001 give market penetration as:

Taiwan	95%
Austria	85%
Finland	81%
Iceland	90%
Israel	90%
Luxembourg	88%

with statistics being even higher for younger age groups.

The mixing of distance learning with mobile telephony to produce mLearning will provide the future of learning.

A certain urgency is implied in the development of mobile learning. There are two reasons for this:

1. The telecommunications industry is in need of revenue generating applications. The move to GPRS (2.5G) and UMTS (3G) is coming and applications are being developed for a range of life situations. Mobile learning is the application for training and learning and needs to be ready for the arrival of 3G technologies, which will make it more viable.

2. The second reason comes from the history of distance education. This history shows clearly that Europe gained world leadership in distance education in the 1970s with the foundation of the Open Universities in the UK, in Spain and in Germany, and with the development of the CNED in France.

   But this leadership did not transfer to e-learning. There was what we might call a Telecommunications Revolution in the 1980s and in America this was quickly harnessed for education with the adoption of satellite and videoconferencing systems – enabling one to teach groups of students at a distance as opposed to the individualised distance programmes which continued to be the norm in Europe.

> These American initiatives led seamlessly to the WWW and Europe was left behind. Today the billion-dollar e-learning industry is dominated by American interests: LMSs like WebCt and Blackboard; standardization protocols like SCORM and IMS; American pedagogical concepts little suited to European education like the templating of content, quizzing, chatting, multiple-choice questioning.

It is generally accepted that European companies like Ericsson and Nokia have given Europe leadership in wireless technologies. The need for training applications for wireless devices is urgent.

In this context the two halves of mobile learning are developing differently.

A reading of the literature of mobile learning which comes from:

- www.google.com
- The Mobile Learning Forum: www.pjb.co.uk/m-learning
- ECLIPSE: www.e-learningcentre.co.uk/eclipse/resources/mlearning.htm.

gives the indication that there is a good deal of activity in the US on training developments for PDAs and palmtops – to this must be added the considerable achievements by NKI in Norway reported in this study.

Mobile telephony is more problematic. There seem to be only 3 projects actively addressing the provision of training for mobile telephones. All of them are European and all are funded by the European Commission:

- From elearning to mlearning (Leonardo da Vinci)
- MLearning: Communications technologies for young adults learning and skills development (IST) LSDA UK
- Mobilearn Giunti Ricerca, Genoa, Italy (IST).

The future, nevertheless, is with mobile telephony. The ownership of PDAs in the world is put at 2.000.000 and sales are static. The ownership of mobile phones is put at nearly 1.000.000.000 out of a world population of 6 billion. The future of mobile learning, therefore, depends on solving the problems inherent in presenting training scenarios on mobile telephones.

The ways to achieve this are:

Make optimal use of:

- Portability (learning anytime/anywhere, just in time)
- Location (eg real-time video of workplace scenario)
- Wearability (expert in your pocket; easy and attractive to wear)
- Networked communication (coached collaborative learning)
- Personalisation (learner-centered design, photo, audio, SMS)
- Blended learning (+classroom, e-learning)

Increase:

- Speed
- Bandwidth
- Memory
- Ease of use
- Durability
- Input/output quality

Decrease:

- Size
- Weight
- Power demands
- Maintenance
- Price

Design educationally sound learning that is:

- Interactive
- Authentic
- Collaborative
- User-centered
- Media rich

Achieve certification for mobile learning courses.

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